7. WASTE AREA GROUP 4 (CENTRAL FACILITIES AREA)

The Central Facilities Area (CFA) was originally built and operated by the U.S. Navy as a proving ground for battleship guns and to conduct other munitions experiments. Construction of the proving ground facility was completed in 1943. The Navy continued to use the facilities until 1949, when munitions experiments were discontinued.

Since then, the U.S. Department of Energy (DOE) has used CFA to house numerous support services for Idaho National Laboratory (INL) Site operations, including administrative offices, research laboratories, a cafeteria, emergency and medical services, construction and support services, workshops, warehouses, vehicle and equipment pools, bus operations, laundry facilities, landfills, and a sewage treatment plant. Some of the support activities have resulted in releases of organic and inorganic contaminants at CFA sites such as storage tanks, dry wells, disposal ponds, and a sewage plant. Consequently, CFA was designated as Waste Area Group (WAG) 4 under a federal facilities agreement and consent order (FFA/CO) (DOE-ID 1991). Remedial action determinations for WAG 4 sites are documented in three records of decision (RODs) and one explanation of significant differences (ESD) to the Operable Unit (OU) 4-13 ROD.

The first WAG 4 ROD—signed on December 31, 1992—addressed OU 4-11, which is the CFA motor pool pond (DOE-ID 1992). The ROD resulted in no action, with potential risk via the groundwater pathway to be evaluated in a comprehensive remedial investigation/feasibility study (RI/FS) (DOE-ID 2000a).

The second ROD—issued on October 10, 1995—addressed the OU 4-03 underground storage tank sites and CFA Landfills I, II, and III (designated as Sites CFA-01, -02, and -03, respectively) (DOE-ID 1995). That ROD upheld the no-further-action determinations for 19 underground storage tank sites. It also documented that these sites pose no risk to human health and the environment and that the sites require no institutional controls. The no-further-action designation used to classify these sites was the appropriate terminology for 1995; however, since the ROD was signed, “no further action” has been modified to designate a site that does not require further remedial actions but does require institutional controls. Therefore, the no-further-action designation of these 19 storage tanks is equivalent the current “no-action” designation. The ROD also required the installation of compacted native soil covers over the three landfills as a presumptive remedy. As part of the remedy, soil vapor, moisture infiltration, and groundwater monitoring was required in order to evaluate the effectiveness of the soil covers. Groundwater monitoring at WAG 4 is conducted under the OU 4-12 post-ROD monitoring work plan (INEEL 2003a). The monitoring began in 1996 and will continue until a five-year review shows that some or all of the monitoring activities can cease.

Following completion of the first two RODs, seven time-critical removal actions were performed at the lead shop (Site CFA-06), tank farm (Site CFA-42), and lead storage yard (Site CFA-43), where soil contaminated with antimony, arsenic, lead, and petroleum products were excavated (INEL 1997). Other time-critical removal actions were conducted at the mercury pond (Site CFA-04), the lead shop (Site CFA-06), the lead storage area (Site CFA-43), the French drains (Site CFA-07), and the tank farm spills (Site CFA-42). Non-time-critical removal actions were performed at the dry wells (Sites CFA-13 and -15) and tank farm (Site CFA-42), where the dry wells were abandoned (no contaminated soils were found) and additional petroleum-contaminated soils were excavated and disposed from Site CFA-42 (INEEL 1998).

The WAG 4 comprehensive RI/FS (DOE-ID 2000a) evaluated 52 potential release sites and determined that 45 of those sites posed no unacceptable risk to human health or the environment, so they were designated as no-action sites.

The third ROD for WAG 4 is the *Final Comprehensive Record of Decision for Central Facilities Area Operable Unit 4-13* (DOE-ID 2000b), which was signed in July 2000. That ROD determined that remedial actions were necessary at the mercury pond (Site CFA-04), the sewage treatment plant drainfield (Site CFA-08), and the transformer yard (Site CFA-10). The ROD also contained a review of the results of the time-critical removal actions and stated that no additional remedial actions were necessary; however, institutional controls were required at Site CFA-07 (French drains).

An ESD to the OU 4-13 ROD (DOE-ID 2003b), issued in May 2003, documents differences to the selected remedy for the CFA-04 mercury pond remedial actions. This ESD increased the final remediation goal for the CFA-04 mercury pond remedial action from 0.5 mg/kg to 8.4 mg/kg and eliminated the requirement to backfill the pond with clean soil to the surrounding grade. The 8.4-mg/kg value is an ecological value based on 10 times the average background concentration for composited samples.

Table 7-1 lists the CFA release sites that required remediation, the contaminants of concern (COCs) for each site, and the cleanup goals for each site. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601 et seq.) remedial actions at CFA are proceeding in accordance with requirements identified in the three records of decision (RODs).

Table 7-1. COCs for WAG 4.

Site (Site Code)	COC	Remediation Goals[a,b]
Landfills I, II, and III (CFA-01, -02, and -03)	Not applicable[b]	Not applicable[b] (containment)
Mercury Pond (CFA-04)	Mercury	8.4 mg/kg
Sewage Plant Drainfield (CFA-08)	Cs-137	Not applicable (containment)
Transformer Yard (CFA-10)	Lead	400 mg/kg

a. The maximum Cs-137 concentration at the CFA-08 drainfield (180 pCi/g) will naturally decay to 23 pCi/g in the 100-year institutional control period for the INL Site. However, the ultimate goal for unrestricted access is 2.3 pCi/g, the 1E-04 future residential risk-based concentration. That concentration will be achieved in an additional 89 years through continued natural decay. Note that 23 pCi/g is not a true "remediation goal" in that soil is being removed to this level; the goal will be achieved through radioactive decay. Confirmatory soil sampling to demonstrate that this level is achieved during the 100-year period will not be performed under this remedy, because the known radioactive half-life for Cs-137 is 30 years.

b. The OU 4-12 ROD does not detail specific COCs or remedial action goals. The remedies for CFA Landfills I, II, and III were implemented in accordance with Environmental Protection Agency presumptive remedy guidance (DOE-ID 1995).

Figure 7-1 shows the locations of the CERCLA sites at WAG 4. Table 7-2 provides a chronology of significant events at WAG 4.

7.1 Remedial Actions

7.1.1 Remedy Selection

Remedies were selected for the WAG 4 sites identified as posing unacceptable risks. The CERCLA remedy selection process, as described in the RODs (DOE-ID 1995; DOE-ID 2000b), was used to identify and select the remedies for each of the sites. The following are brief descriptions of the WAG 4 selected remedies.

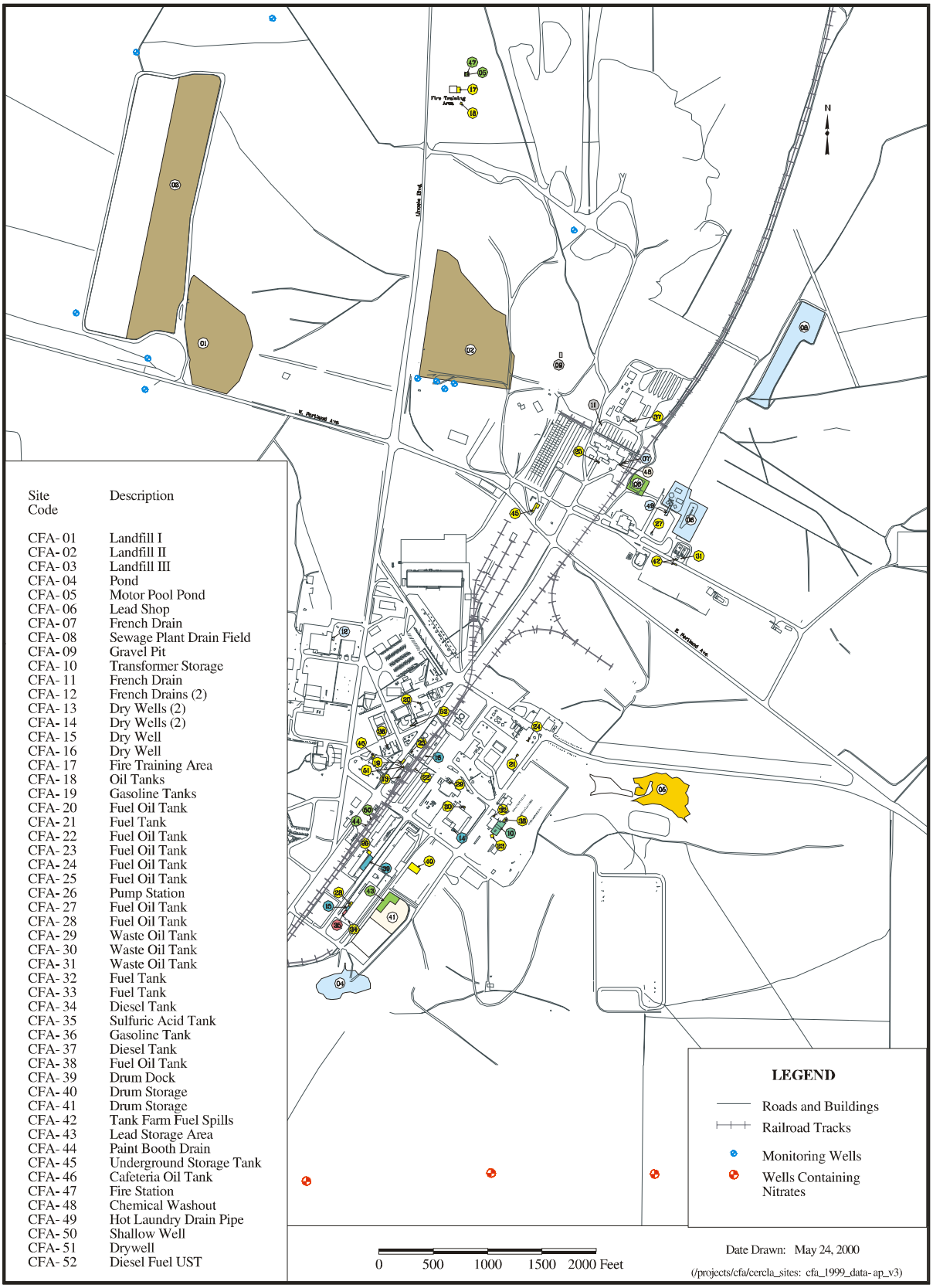


Figure 7-1. WAG 4 CERCLA sites.

Table 7-2. Chronology of WAG 4 events.

Event	Date
The initial assessment of the mercury pond (Site CFA-04) was completed.	October 1986
The *Record of Decision – Central Facilities Area Motor Pool Pond, Operable Unit 4-11, Waste Area Group 4* (DOE-ID 1992) was signed.	December 1992
The time-critical removal action for the mercury pond (Site CFA-04) was completed.	1994
Time-critical removal action at the French drains (Site CFA-07) was completed.	1995
The *Record of Decision Declaration for Central Facilities Area Landfills I, II, and III (Operable Unit 4-12) and No Action Sites (Operable Unit 4-03)* (DOE-ID 1995) was signed.	October 1995
The *Remedial Design/Remedial Action Work Plan for Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (DOE-ID 1996) was completed.	April 1996
The remedial action at CFA Landfills I, II, and III began.	June 1996
The remedial action at CFA Landfills I, II, and III ended.	April 1997
The *Post Record of Decision Monitoring Work Plan Central Facilities Area Landfills I, II, and III Operable Unit 4-12* (INEEL 2003a) was completed.	June 1997
The *Remedial Action Report CFA Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (DOE-ID 1997) was completed.	September 1997
The *Comprehensive Remedial Investigation/Feasibility Study for the Central Facilities Area Operable Unit 4-13 at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2000a) was completed.	July 2000
The *Final Comprehensive Record of Decision for Central Facilities Area Operable Unit 4-13* (DOE-ID 2000b) was signed.	July 2000
The *Remedial Design/Remedial Action Work Plan Idaho National Engineering and Environmental Laboratory Central Facilities Area, Operable Unit 4-13, Transformer Yard (CFA-10)* (DOE-ID 2001) was completed.	April 2001
The remedial action at the transformer yard (Site CFA-10) began.	June 2001
The remedial action at the transformer yard (Site CFA-10) ended.	August 2001
The *Remedial Design/Remedial Action Work Plan for Waste Area Group 4, CFA-08 Sewage Plant Drainfield, OU 4-13* (DOE-ID 2002a) was completed.	March 2002
The remedial action at the sewage plant drainfield (Site CFA-08) began.	March 2002
The *Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13* (DOE-ID 2002b) was completed.	March 2002
The *Construction Complete Report for the Idaho National Engineering and Environmental Laboratory, Central Facilities Area, Operable Unit 4-13, Transformer Yard (CFA-10)* (DOE-ID 2002c) was completed.	April 2002
The remedial action at the sewage plant drainfield (Site CFA-08) ended.	November 2002
The statutory five-year review of CFA Landfills I, II, and III took place (DOE-ID 2002d).	November 2002
The *Waste Area Group 4 Remedial Design/Remedial Action Work Plan, CFA-04 Pond Mercury-Contaminated Soils, Operable Unit 4-13* (DOE-ID 2003a) was completed.	February 2003

Table 7-2. (continued).

Event	Date
The *Construction Complete Report for the Idaho National Engineering and Environmental Laboratory, Central Facilities Area, Operable Unit 4-13, CFA-08 Sewage Plant Drainfield* (DOE-ID 2003c) was completed.	June 2003
The *Explanation of Significant Differences for the Record of Decision for the Central Facilities Area, Operable Unit 4-13* (DOE-ID 2003b) was completed.	February 2003
The remedial action at the mercury pond (Site CFA-04) began.	June 2003
The remedial action at the mercury pond (Site CFA-04) ended.	November 2003
The *Remedial Action Report for the Idaho National Engineering and Environmental Laboratory, Central Facilities Area, Operable Unit 4-13* (DOE-ID 2004a) was completed.	September 2004

7.1.1.1 Landfills I, II, and III (Sites CFA-01, -02, and -03). The selected remedial action for the CFA landfills was installation of compacted native soil covers. Additionally, routine groundwater monitoring, soil vapor monitoring, and moisture infiltration are required to ensure the covers are functioning as intended. Institutional controls, including routine monitoring of the soil covers, signage, fencing, and access controls, were identified.

7.1.1.2 Mercury Pond (Site CFA-04). The selected remedy for the mercury pond included excavation, treatment by stabilization, and disposal (on the INL Site) of the pond's mercury-contaminated soil. Institutional controls were to be implemented if necessary, based on the effectiveness of the remedial action.

7.1.1.3 Sewage Plant Drainfield (Site CFA-08). The selected remedy for the sewage plant drainfield was containment with an engineered cover. Performance standards were implemented as design criteria for the site to ensure that the engineered cover protects human health and the environment. Institutional controls are required to be maintained and include fencing, signage, access restriction, and routine monitoring of the engineered cover.

7.1.1.4 Transformer Yard (Site CFA-10). The selected remedy for the transformer yard included characterization and excavation of lead-contaminated soil that exceeded the remedial action goal. Soil that required treatment was stabilized and disposed of at an off-site facility. Soil that did not require treatment was excavated and disposed of onsite.

7.1.1.5 Institutional Control Sites. As specified in the OU 4-13 ROD (DOE-ID 2003b), institutional controls have been established at five WAG 4 sites. Institutional controls are required at (a) the Landfills I, II, and III (Sites CFA-01, -02, -03) to ensure that future activities do not compromise the integrity of the covers, (b) the French drains (Site CFA-07) because the residual lead concentration exceeds the U.S. Environmental Protection Agency (EPA) residential screening level at depth below 10 ft, and (c) the sewage plant drainfield (Site CFA-08) because the Cs-137 concentrations exceed risk-based levels for the 100-year future residential scenario. A brief description of the objectives of the institutional controls for each site is provided below:

- **Landfills I, II, and III (Sites CFA-01, -02, and -03)—**Maintain the integrity of the cover by restricting drilling and excavation activities and by establishing visible access restrictions.

- **French Drains (Site CFA-07)—**Limit residential land use for depths greater than 10 ft by implementing visible access restrictions.

- **CFA-08 (Sewage Treatment Plant Drainfield)—**Prevent exposure to contaminated soil by restricting drilling and excavation activities and by implementing visible access restrictions.

7.1.2 Remedial Action Objectives

Remedial action objectives (RAOs) for the CFA sites were developed in accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," and CERCLA RI/FS guidance through meetings with the Idaho Department of Environmental Quality, the EPA, and the DOE. The RAOs result from risk assessments and are specific to the COCs and exposure pathways developed for OUs 4-12 and 4-13.

To meet the RAOs, preliminary remediation goals were established as quantitative cleanup levels based primarily on applicable or relevant and appropriate requirements and risk-based doses. Final remediation goals, as presented in Table 7-1, are based on the results of the baseline risk assessment and an evaluation of expected exposures and risks for selected alternatives. Remedial actions were completed to ensure that risks would be mitigated and exposure would not exceed the final remediation objectives.

The RAOs for protection of human and environmental health and safety are described below for each of the sites.

7.1.2.1 Landfills I, II, and III (Sites CFA-01, -02, and -03). The RAOs for Landfills I, II, and III are as follows:

- Prevent direct contact with the landfill contents.

- Minimize the potential for erosion and infiltration at the surface.

- Ensure that drinking water standards are not exceeded in the Snake River Plain Aquifer (SRPA) as a result of the migration of contaminants from the landfills.

7.1.2.2 Mercury Pond (Site CFA-04). The RAOs for the mercury pond are as follows:

- Prevent ingestion and inhalation of radionuclide and nonradionuclide COCs that would result in a total excess cancer risk greater that 1 in 10,000 or a total hazard index greater than 1.0.

- Prevent exposure of ecological receptors to contaminated soil with concentrations greater than or equal to a screening level of 10 times background values that result in a hazard quotient greater than or equal to 10.

7.1.2.3 Sewage Plant Drainfield (Site CFA-08). The ROAs for the sewage plant drainfield are as follows:

- Prevent direct human exposure to radionuclides that would result in total excess cancer risk greater than 1 in 10,000.
- Prevent ingestion and inhalation of Cs-137 that would result in a total excess cancer risk greater than 1 in 10,000 or a total hazard index greater than 1.0.
- Prevent exposure of ecological receptors to contaminated soil with concentrations greater than or equal to a screening level of 10 times background values that result in a hazard quotient greater than or equal to 10.
- Monitor the groundwater at WAG 4 until the nitrate levels fall below the 10-mg/L maximum contaminant level (MCL).

7.1.2.4 Transformer Yard (Site CFA-10). The RAO for the transformer yard is to prevent exposure to lead at concentrations over 400 mg/kg, the EPA residential screening level for lead.

7.1.3 Remedy Implementation

The following subsections describe the remedial and removal actions implemented at the WAG 4 sites. Full descriptions of the remedial actions are in the *Remedial Action Report CFA Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (DOE-ID 1997) and the *Remedial Action Report for the Idaho National Engineering and Environmental Laboratory, Central Facilities Area, Operable Unit 4-13* (DOE-ID 2004a); additional information regarding the time-critical removal action at the French drain site (CFA-07) can be found in the preliminary scoping Track 2 summary report (INEL 1996).

7.1.3.1 Landfills I, II, and III (Sites CFA-01, -02, and -03). The remedial action at the CFA landfills consisted of installing native soil covers and environmental monitoring equipment. The covers consist of three layers: (1) general backfill to bring the existing grade up to the design slope; (2) a compacted low-permeability soil layer to inhibit the transport of moisture to the landfill contents; and (3) a topsoil layer for the final grade, allowing for vegetation growth. Additionally, a layer of riprap was placed in the northeast corner of Landfill II to provide slope stability. A detailed description of the remedial action is contained in the remedial action report for the CFA Landfills I, II, and III (DOE-ID 1997).

As part of the CFA landfills preemptive remedy, environmental monitoring equipment was installed in and around each of the three landfills covers. Soil moisture monitoring is conducted using neutron access tubes (NATs) and time domain reflectometry. Vadose zone gas sampling is conducted to monitor for potential transport of gases from the landfill, and routine groundwater monitoring is conducted across a network of wells upgradient and downgradient from the landfills. The sampling locations and frequencies for the environmental monitoring points are detailed in the post-ROD monitoring work plan for the landfills (INEEL 2003a).

Institutional controls were established at the landfills to restrict access to the sites. The institutional controls, site-specific operations and maintenance, and environmental monitoring will continue until deemed unnecessary based on the results of a five-year review (DOE-ID 2002b).

7.1.3.2 Mercury Pond (Site CFA-04). The remedial action at the mercury pond consisted of removing mercury-contaminated soils for direct disposal at the CFA bulky waste landfill and direct

disposal and treatment at the Idaho CERCLA Disposal Facility (ICDF). Asbestos-contaminated material and commingled mercury-contaminated soils were excavated and directly disposed of at the CFA bulky waste landfill. Low-level mercury-contaminated soil was excavated and directly disposed of at the ICDF. The low-level, toxicity-characteristic-leaching-procedure (TCLP), mercury-contaminated soil was excavated and shipped to the ICDF for treatment before disposal. Portions of the mercury pond area were excavated to basalt. In these locations and others where the excavation was extensive (i.e., asbestos area), fill material was brought in to bring the area up to preconstruction grade. The excavation area was covered with topsoil, contoured, and revegetated.

As detailed in the remedial action report (DOE-ID 2004a), the average mercury concentration in soil remaining in the pond area is below the remedial action goal of 8.4 mg/kg, so no institutional controls were identified for the site, and the site will not be included in subsequent five-year reviews. Additional details about the remedial action at the pond are contained in the remedial action report for OU 4-13 (DOE-ID 2004a).

7.1.3.3 Sewage Plant Drainfield (Site CFA-08). The remedial action at the sewage plant drainfield consisted of an engineered cover designed to prevent intrusion into the drainfield by humans or animals. Before the cover materials were put in place, the vegetation in the area was mowed and proof-rolled. Additionally, the drainfield distribution boxes were collapsed and backfilled to existing grade. Material was then put in place to construct the engineered cover. The layers composing the cover include cobble, pea gravel, and native soil. The cobble and pea gravel layers are intended to prevent animal intrusion into the waste, and the native soil layer is intended to foster vegetation growth. After placement of materials, the construction and support areas were revegetated, and a chain-link fence was erected around the perimeter of the engineered cover to prevent inadvertent human intrusion. Concrete survey monuments were placed per the OU 4-13 operations and maintenance plan (DOE-ID 2002b). A detailed description of the CFA-08 remedial action is provided in the remedial action report for OU 4-13 (DOE-ID 2004a).

Contamination was left in place at the sewage plant drainfield. As required by EPA Region 10 policy (EPA 1999) and as prescribed by the remedy (DOE-ID 2000b), institutional controls are required at Site CFA-08. A detailed discussion of the institutional controls evaluation and implementation is provided in the OU 4-13 operations and maintenance plan (DOE-ID 2002b).

7.1.3.4 Transformer Yard (Site CFA-10). The remedial action goal was met at the transformer yard by excavating and removing lead-contaminated soil. All soil with lead concentrations exceeding 400 mg/kg was excavated from the site. Excavated soil identified as characteristic for Resource Conservation and Recovery Act hazardous waste (by TCLP) were properly packaged and transported to an off-site facility that was permitted for treatment, storage, and disposal. All other lead-contaminated soil (i.e., with TCLP lead concentrations < 5 mg/L) were designated nonhazardous waste and then transported to and disposed of at the CFA bulky waste landfill. Institutional controls were not identified for Site CFA-10, because all contaminated media posing unacceptable risks were removed. As a result, this site will not be considered under any subsequent five-year reviews. Additional details about the remedial action at the transformer yard are in the remedial action report for OU 4-13 (DOE-ID 2004a).

7.2 Data Evaluation

Post-remedial action sampling and data evaluation are not required for Sites CFA-04, -07, -08, or -10. Consequently, the data evaluation will focus on the routine groundwater samples, gas samples from boreholes, moisture monitoring data from NATs, and data from time-domain reflectometer (TDR) arrays. The following subsections provide (a) a review and assessment of the annual site inspections for the CFA landfills and the sewage plant drainfield and (b) an evaluation of routine monitoring data

collected for the CFA landfills since the last five-year review. Operational and sampling procedures for the groundwater sampling, gas sampling, and moisture monitoring are outlined in the *Post Record of Decision Monitoring Work Plan, Central Facilities Area Landfills I, II, and III Operable Unit 4-12* (INEEL 2003a).

The *Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13* (DOE-ID 2002b) describes the activities and procedures required for maintenance of sites that remain under institutional controls. Basic elements of the operations and maintenance plan include a description of inspection, maintenance, and repair procedures for the vegetative cover, soil cover, rock armor, and monitoring equipment associated with the CFA landfills. The operations and maintenance plan also includes descriptions of inspection and maintenance activities for Sites CFA-07 and -08 as well as detailed instructions regarding the periodic radiological survey to be conducted at the CFA-08 sewage plant drainfield cover.

7.2.1 Site Inspections

Operations, maintenance, and institutional control inspections are conducted annually at the five OU 4-13 sites requiring institutional controls. The following are summaries of the annual inspections conducted for the CFA landfills, French drains, and sewage plant drainfield.

7.2.1.1 Sites CFA-01, -02, and -03 Annual Inspection. The annual operations, maintenance, and institutional control inspection for fiscal year (FY) 2002 was conducted on October 16, 2002 (DOE-ID 2002e). Visible access restrictions, activity control, and unauthorized access and land-use restrictions were evaluated at Sites CFA-01, -02, and -03. No deficiencies were identified. The soil covers at Sites CFA-01, -02, and -03 were inspected for vegetation cover, erosion, subsidence, and intrusion. The vegetation on the covers is generally well established. Minimal encroachment of rabbit brush at Landfill I and small areas of sparse vegetation on Landfills II and III were identified. Small mammal burrows and minor erosion rills were also identified. The rabbit brush was removed, burrows and rills were filled, and all affected areas were revegetated during FY 2003 maintenance activities.

Topographic surveys were conducted in 2002 and 2005 at Sites CFA-01, -02, and -03 and at the rock armor on the north end of Site CFA-02 in accordance with the operations and maintenance plan. Data from the surveys were evaluated to ascertain whether any large-scale subsidence or structural failure of the covers had occurred. The results of the topographic surveys indicated no subsidence or failure.

The annual operations, maintenance, and institutional controls inspection for FY 2003 was conducted on November 19, 2003 (DOE-ID 2004b). Visible access restrictions, control of activities, unauthorized access, and land-use restrictions were evaluated. No deficiencies were identified. The soil covers at Sites CFA-01, -02, and -03 were inspected for vegetation cover, erosion, subsidence, and intrusion. In general, the vegetative cover at the sites is well established. Maintenance activities conducted in FY 2003 resulted in removal of the weeds and encroaching plants identified during the FY 2002 inspections. Vegetation at the CFA-08 cover is sparse, but new growth was identified, and vegetation will continue to be monitored.

During the routine NAT monitoring activities at Landfill III conducted in October 2004, subsidence due to differential settling was discovered approximately 60 to 70 yd south of the NAT/TDR array. The subsidence is circular with an approximate diameter of 6 ft and has compromised the integrity of the Landfill III cover (Figure 7-2). This subsidence was also noted during the annual operations and maintenance inspection at the CFA landfills and is documented in the annual operations and maintenance report (DOE-ID 2005).

Figure 7-2. Subsidence discovered in the CFA Landfill III cover.

7.2.1.2 Site CFA-07 Annual Inspections. The time-critical removal action at Site CFA-07 was completed in 1995. Because contamination remains in place, institutional controls are maintained at the site and are subject to annual inspections. Annual inspections conducted in 2002, 2003, and 2004 verified the placement and effectiveness of the postings and administrative controls.

7.2.1.3 Site CFA-08 Annual Inspections. The remedial action at Site CFA-08 was completed the fall of 2002; as such, operations and maintenance activities at this site were limited but provided a baseline for subsequent inspections. The signage and newly constructed fence were verified to be in place, as specified in the remedial action report (DOE-ID 2004a). A radiological survey was completed in 2002 to quantify the apparent concentration of Cs-137 in the soils at Site CFA-08 and to provide a baseline against which future surveys can be compared. The results of the survey demonstrated that Cs-137 concentrations are well below the INL Site background. Radiological surveys were not performed in 2003 or 2004. The next radiological survey is scheduled for FY 2005.

7.2.2 CFA Groundwater Monitoring

In accordance with the ROD (DOE-ID 1995), groundwater monitoring has been conducted to (a) establish a baseline of potential contaminant concentrations in the SRPA against which future data can be compared and (b) ensure that drinking water standards are not exceeded in the SRPA because of migration of contaminants from the landfills. Groundwater samples were collected from 11 wells in the vicinity of the CFA landfills. The sampling rationale is described in Table 7-3, and sampling locations are shown on Figure 7-3. Groundwater samples were collected and analyzed for volatile organic compounds (VOCs), anions, metals, and alkalinity. Groundwater levels were measured at the 11 wells that are routinely sampled and at 19 other wells located in the vicinity of the CFA landfills (Figure 7-3). The following discussion covers groundwater monitoring results since the last five year review (DOE-ID 2002d) and, specifically, the results contained in the annual reports for 2002 and 2003 (INEEL 2003b; ICP 2004a).

Table 7-3. Groundwater monitoring wells and sampling rationale.

Well	Well Completion (ft below land surface)	Sampling Rationale
LF 2-08	Screened (485–495)	Downgradient of Landfill II
LF 2-09	Screened (469.6–497)	Downgradient of Landfill II
LF 2-11	Screened (484–499)	Upgradient of Landfill II
LF 3-08	Screened (500–510)	Downgradient of Landfills I and III
LF 3-09	Screened (490–500)	Downgradient of Landfills I and III
LF 3-10	Screened (481–501)	Adjacent to Landfill III
USGS-083	Screened (516–752)	Downgradient of Landfills I, II, and III
USGS-128	Screened (457–615)	Upgradient of Landfills I and III
CFA-MON-A-001	Screened (488–518)	Downgradient of CFA
CFA-MON-A-002	Screened (488–518)	Downgradient of CFA
CFA-MON-A-003	Screened (488–518)	Downgradient of CFA

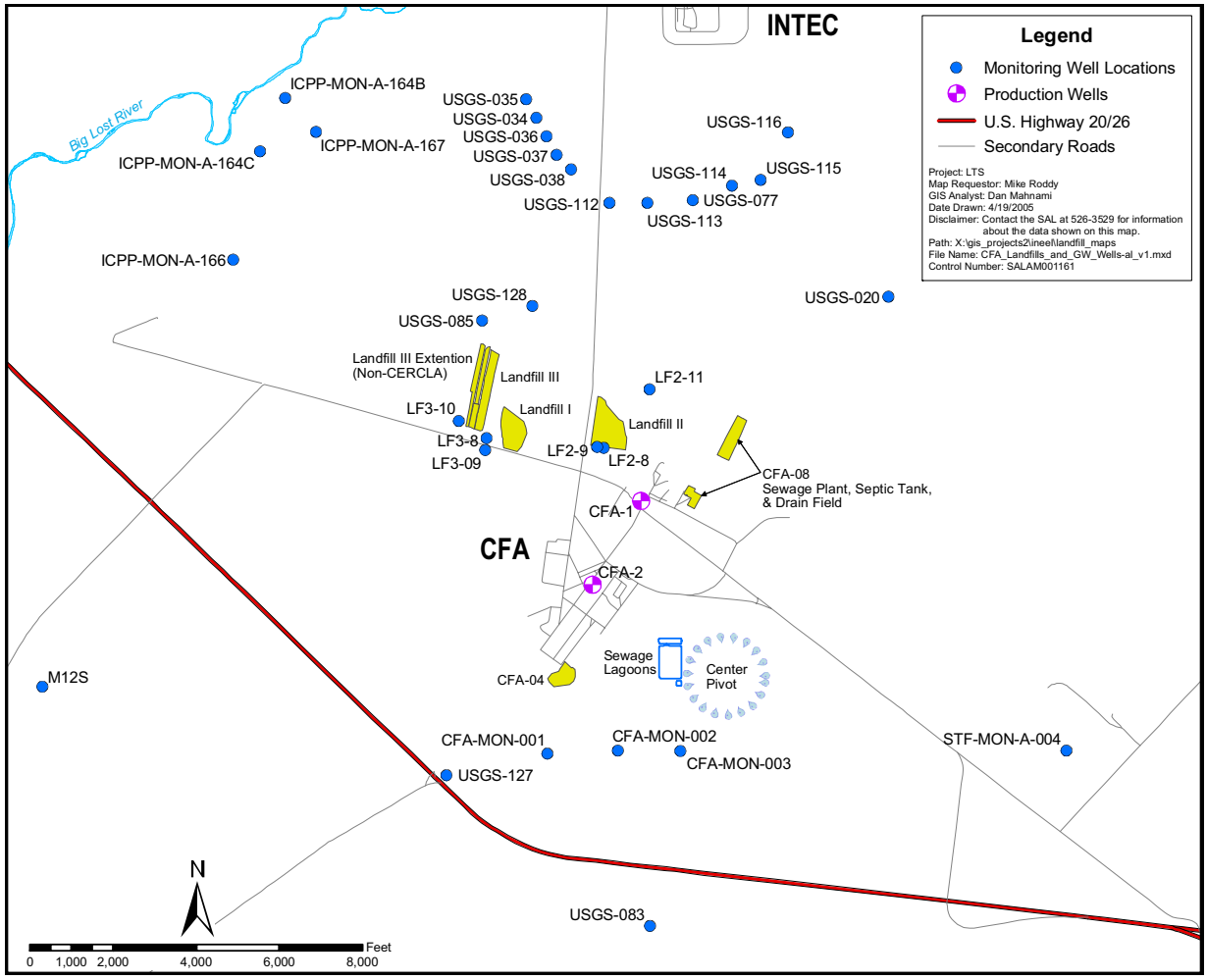


Figure 7-3. Groundwater monitoring wells and water-level measurement wells.

7.2.2.1 Groundwater Sampling Data. A comparison of the maximum concentrations for detected analytes versus background and the defined regulatory level is provided in Table 7-4. Elevated nitrate concentrations (i.e., levels greater than the 10-mg/L MCL for sensitive populations) have been present in Wells CFA-MON-A-002 and -003. As defined, sensitive populations include infants. Nitrate concentrations in all other wells were equal to or less than 4 mg/L. The nitrate concentrations in CFA-MON-A-002 and -003 have remained relatively steady over time (Figure 7-4).

In a few wells, aluminum and iron occasionally exceeded their respective secondary MCLs of 200 μg/L and 300 μg/L (Table 7-4). The elevated aluminum concentrations in two wells, LF2-11 and CFA-MON-A-003, probably are due to suspended solids, because aluminum solubility is very low at the near-neutral pH found in these wells. The principal control of dissolved aluminum concentrations is pH. The solubility of iron is controlled by pH and dissolved oxygen concentration. Iron is soluble in low pH conditions or in the absence of dissolved oxygen. The occasional occurrences of elevated iron concentrations are inconsistent with the high dissolved oxygen concentrations and neutral to slightly alkaline pH present in these wells. The chemical inconsistency suggests that the iron is from suspended solids or well materials rather than being in solution.

Lead and zinc concentrations in groundwater samples collected from several wells as part of the CFA groundwater monitoring and sampling program were anomalously high in the past. The higher concentrations of iron, lead, and zinc in the several of the CFA monitoring wells were the result of corrosion of galvanized riser pipe used in the well construction; after the galvanized riser pipes were replaced, the lead and zinc concentrations decreased sharply (Figure 7-5). This was also observed at the WAG 5 wells after the galvanized riser pipes were replaced (ICP 2004b).

In 2003, nitrogen and oxygen isotope ratios in nitrate were ascertained for seven wells in order to verify the source of the nitrate in the CFA-MON-A-002 and -003 monitoring wells (ICP 2004a). The sewage plant drainfield (Site CFA-08) had been previously implicated as the source of the nitrate contamination, based on a nitrogen isotope study conducted in 2000 and the assumption that groundwater flow was to the southwest (INEEL 2002). The nitrogen isotope analysis was redone with the addition of the oxygen isotope ratios in nitrate, because the groundwater flow map in the 2002 annual monitoring report (INEEL 2003b) did not support Site CFA-08, because the source of the nitrate and the oxygen isotope ratio in nitrate was not determined in the study conducted in 2000. The nitrogen isotope ratios for the CFA-MON wells were similar in both studies. Consequently, the oxygen isotope ratios in nitrate were used to differentiate the source of the nitrate. The CFA-MON wells do not have oxygen isotope ratios in nitrate that would indicate nitrification and/or denitrification of sewage. The nitrogen and oxygen isotope ratios in nitrate suggested a manufactured source of nitrate—like nitric acid. Both the water-level map (Figure 7-6) and the isotope data suggest that the dry pond (Site CFA-04) is the source of the nitrate.

The wells in the vicinity of the CFA landfills have elevated levels of sodium and chloride relative to background concentrations (Table 7-4). The elevated sodium and chloride concentrations in the CFA landfill wells are due to upgradient impacts from the Idaho Nuclear Technology and Engineering Center (INTEC) (DOE-ID 2002c; DOE-ID 2003d). Sodium and chloride concentrations have remained relatively steady in the landfill wells since they were first sampled.

In addition to WAG 4 monitoring, WAG 3 Group 5 conducts annual groundwater sampling at two CFA landfill wells for selected radionuclides to track INTEC plumes. The WAG 3 Group 5 groundwater sampling also indicated that increasing concentrations of Sr-90 originating from INTEC might be progressing toward CFA. Currently, tritium, Tc-99, gross beta, and Sr-90 concentrations do not exceed the MCLs in groundwater underlying the CFA. Details about the locations and concentrations of INTEC plumes are contained in DOE-ID (2002f; 2003d).

Table 7-4. Summary of groundwater monitoring results since the last the five-year review (data from 2002 and 2003), background concentrations, and regulatory levels for detected analytes.

Compound	Units	Maximum Detected Value	Location of Maximum Detected Value	MCL or Secondary MCL[a]	LF2-11 Upgradient Well[b]	Background[c]	Detections above Background and Upgradient Well	Number of Wells with Detections above MCL or Secondary MCL (2002, 2003)[d]
Anions								
Alkalinity-bicarbonate	mg/L	317	USGS-128	None	136	*169–174*	No	NA
Chloride	mg/L	117	LF3-09	*250*	107	*16–27*	Yes	0, 0
Fluoride	mg/L	0.235	USGS-083	*2*	0.15	*0.3–0.5*	No	0, 0
Nitrate/nitrite	mg-N/L	21.3	CFA-MON-A-002	10	3.3	1 to 2	Yes	2, 2
Sulfate	mg/L	36.2	USGS-128	*250*	29.6	*24–31*	Yes	0, 0
Common Cations								
Calcium	µg/L	75,900	LF2-09	None	60,400	*43,000–46,000*	Yes	NA
Magnesium	µg/L	25,400	CFA-MON-A-002	None	17,000	*15,000*	Yes	NA
Potassium	µg/L	5,040	LF2-09	None	4,360	*3,100–3,500*	Yes	NA
Sodium	µg/L	44,900	LF2-11	None	44,900	*14,000–17,000*	No	NA
Organic Analytes								
Toluene	µg/L	32	LF2-08	1,000	ND	NA	NA	0, 0
Inorganic Analytes								
Aluminum	µg/L	416	CFA-MON-A-002	*50–200*	240	*10–13*	Yes	1, 1
Arsenic	µg/L	3.7	LF2-09	50/10[e]	ND	2 to 3	Yes	0, 0
Barium	µg/L	184	LF2-09	2,000	160	50 to 70	Yes	0, 0
Beryllium	µg/L	ND	—	4	ND	N	N	0, 0
Cadmium	µg/L	ND	—	5	ND	<1	No	0, 0
Chromium	µg/L	57.8	LF3-09	100	23.3	2 to 3	Yes	0, 0

Table 7-4. (continued).

Compound	Units	Maximum Detected Value	Location of Maximum Detected Value	MCL or Secondary MCL[a]	LF2-11 Upgradient Well[b]	Background[c]	Detections above Background and Upgradient Well	Number of Wells with Detections above MCL or Secondary MCL (2002, 2003)[d]
Copper	µg/L	ND	—	1,300/*1,000*	ND	<1	No	0, 0
Iron	µg/L	1,680	USGS-128	*300*	872	*16–25*	Yes	5, 2
Lead	µg/L	14.5	USGS-128	15[f]	ND	1 to 5	Yes	0, 0
Manganese	µg/L	25.4	USGS-128	50	8.1	*7*	Yes	0, 0
Mercury	µg/L	ND	—	2	ND	N	N	0, 0
Nickel	µg/L	112	LF3-09	None	11.7	N	Yes	NA
Selenium	µg/L	ND	—	50	ND	<1	No	0, 0
Vanadium	µg/L	8.8	USGS-083	None	ND	N	N	NA
Zinc	µg/L	958	USGS-128	*5,000*	ND	*10.5–54*	Yes	0, 0

a. Numbers in italics are for the secondary MCL.
b. Data for LF2-11 are from 2002, because the well could not be sampled in 2003.
c. Background is from two sources. Plain numbers are from Knobel, Orr, and Cecil (1992). Italicized numbers are from USGS (1999)—median and mean values.
d. The first number is for 2002, and the second number is for 2003.
e. The proposed new MCL for arsenic is 10 µg/L, which will take effect in January 2006.
f. The action level for lead is 15 µg/L.

N = not determined
NA = not applicable
ND = not detected

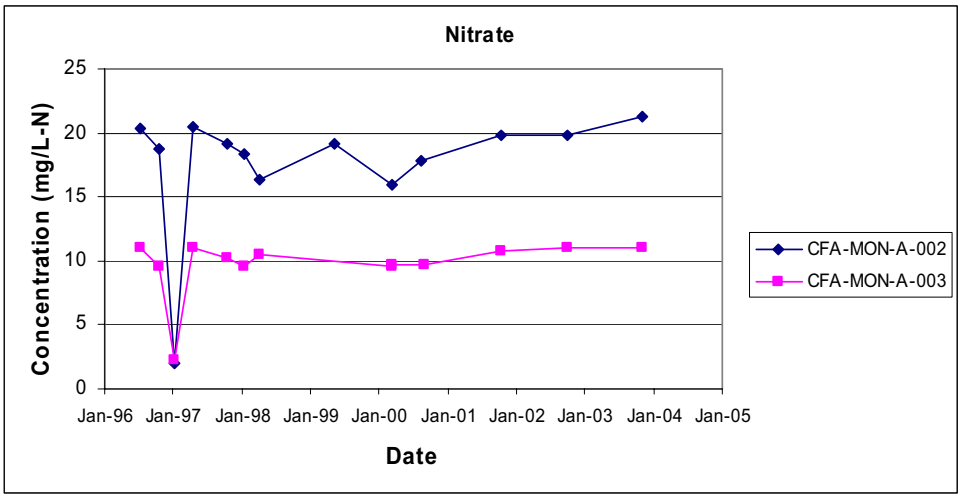


Figure 7-4. Nitrate concentration in Wells CFA-MON-A-002 and -003 (note that the MCL = 10 mg/L).

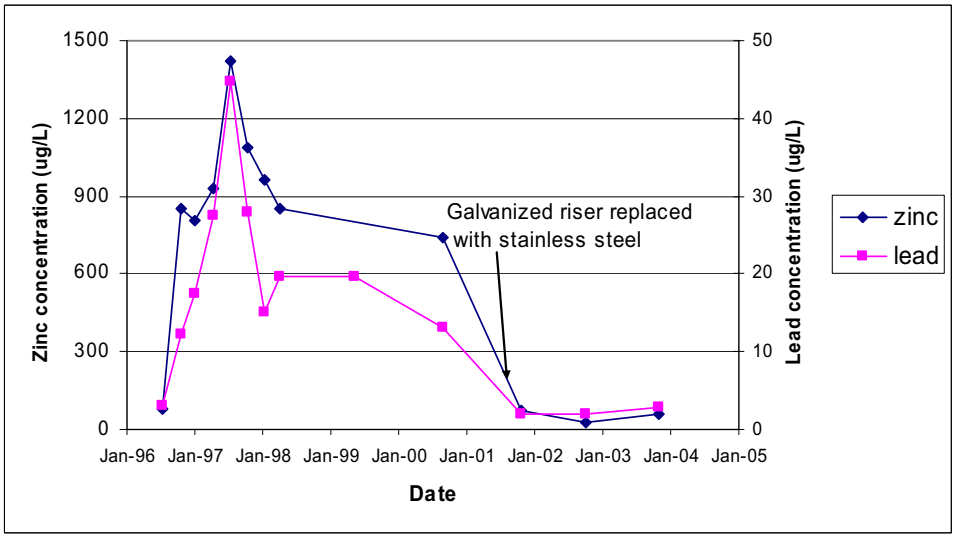


Figure 7-5. Lead and zinc concentrations in Well CFA-MON-A-001.

7.2.2.2 Groundwater-Level Monitoring. Since the last five year review, water levels were measured at 31 wells in October 2002 and at 30 wells at and near CFA in January 2004. The depth to groundwater was ascertained using surveyed measuring point elevations and well deviation correction factors. A groundwater-level contour map for the January 2004 data is shown on Figure 7-6. The apparent groundwater flow direction from CFA Landfills I and III varies from southeast to south to southwest and is consistent for both water-level measurement events. The apparent direction of groundwater flow from Landfill II is predominantly southeast. The groundwater-level contour map shows that parts of Landfills I and II are not covered by the current groundwater monitoring system. Two additional wells were installed in 2005 at CFA Landfills I and II to address this problem. The latest groundwater contour map from January 2004 is consistent with the groundwater contour maps in the previous annual report (INEEL 2003b) and the five-year review (DOE-ID 2002d).

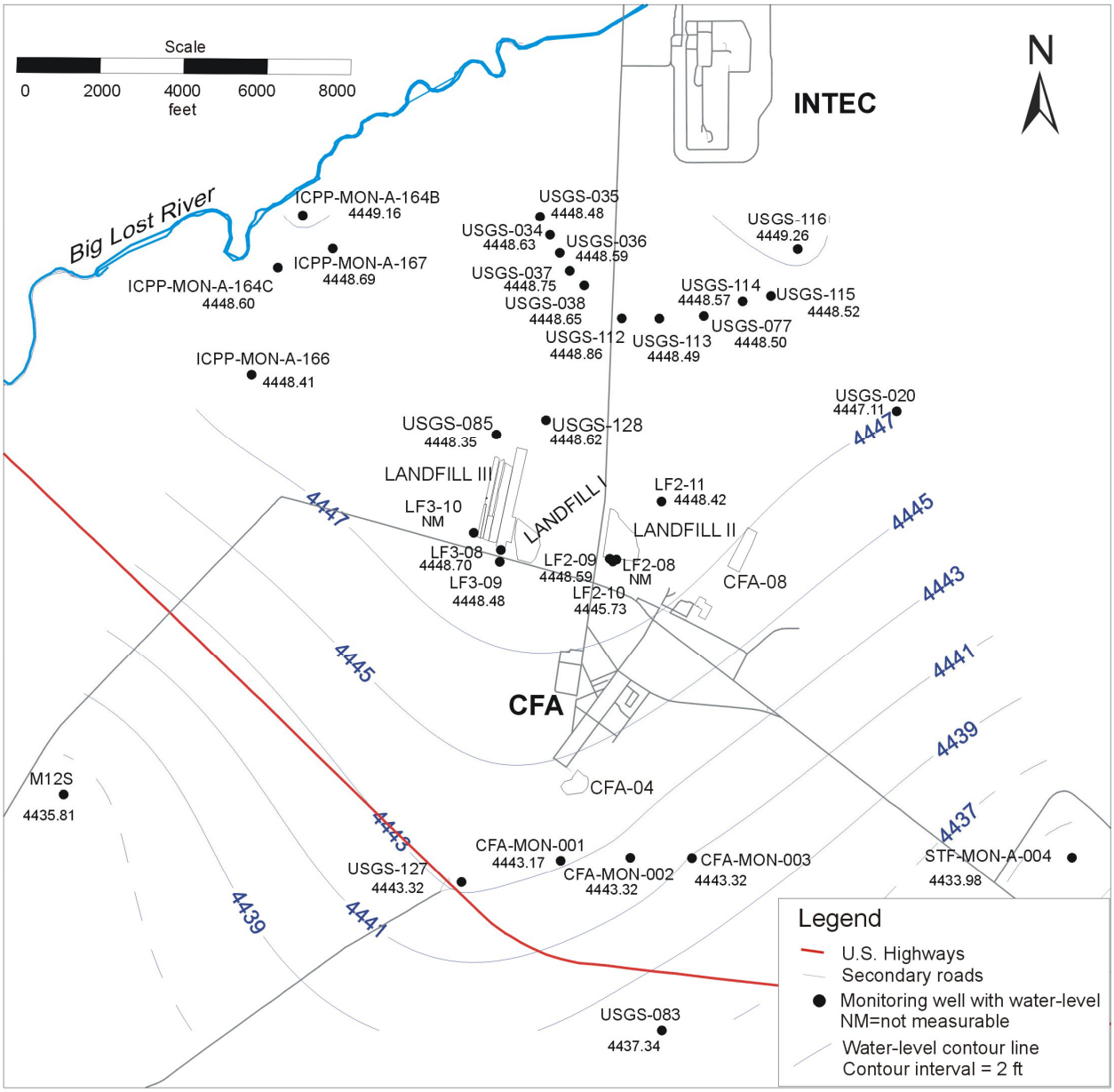


Figure 7-6. Groundwater-level contour map for the CFA area in January 2004 (ICP 2004a).

Although flow directions and gradients do not appear to change, water levels have dropped by over 5 ft since 2001. This drop is the reason that Wells LF2-09 and LF2-11 could not be sampled in 2003. The groundwater gradient in the area covered by the water-level measurements varies considerably (Figure 7-6). The gradient is slight over the area between INTEC and the CFA landfills (more than 1 mi), with less than 2 ft of head difference. Steeper gradients are present south of CFA and to the east of CFA between the Security Training Facility and the Power Burst Facility. From LF2-09 to CFA-MON-A-003, the average gradient is approximately 5.3 ft per mi; from LF3-09 to M12S, the average gradient is about 5.5 ft per mi.

7.2.3 Soil-gas Monitoring

As part of the remedial action, five soil-gas sampling boreholes were installed in the vicinity of the CFA landfills to monitor for soil-gas contaminants. One borehole was installed adjacent to Landfill I, two were installed adjacent to Landfill II, and two were installed adjacent to Landfill III (one of which is proximal to Landfill I). Each borehole was completed with four soil-gas-sampling ports, including two above the shallow interbed and two below it. The soil-gas samples are currently collected in the fall in response to an issue raised in the previous five-year review.

The soil-gas sampling ports are designed to sample soil gases from discrete depths. One shallow sampling port was placed within the surficial sediments at a depth of approximately 13 ft. A second sampling port was placed in basalt at a depth of approximately 38 ft above the shallow interbed, which is located approximately 40 to 60 ft below land surface (bls). Two deep sampling ports were placed below the shallow interbed, with perforated sections vertically separated by approximately 30 ft. The depths of these two ports are approximately 78 and 108 ft. The perforated sections of the deep sampling ports were located adjacent to fracture zones in the basalt, i.e., the most probable avenue of soil-gas migration. Soil gas samples were collected and analyzed for VOCs, including methane.

Historically, VOCs that have been detected consistently in the soil-gas samples include 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane, 1,1-dichloroethene (1,1-DCE), dichlorodifluoromethane, trichlorofluoromethane, trichloroethene (TCE), 1,1,2-trichloro-1,2,2-trifluoroethane (F-113), 1,2-dichloro-1,2,2-tetrafluoroethane (F-114), *cis*-1,2-DCE, carbon tetrachloride, and tetrachloroethene (PCE). These compounds are refrigerants, common solvents, products of solvent degradation, and constituents found in solvents that are used to clean mechanical equipment. Generally, the upper soil gas locations at a depth of 10 to 13 ft bls were low in VOC concentrations, with the highest VOC concentrations at the intermediate sample port depths of approximately 35 to 38 ft bls and 70 to 78 ft bls. The VOC concentrations then generally decreased in samples collected from the lowermost locations at 100 to 108 ft bls. The soil-gas sampling results since the last five-year review are described below.

At GSP1-1, the analytes occurring at the highest concentrations were 1,1,1-TCA, 1,1-DCE, TCE, and trichlorofluoromethane. The concentration trends for these four compounds are shown in Figure 7-7. The trend plots indicate that the concentrations of the above four analytes are increasing at the 37.5-ft sampling depth but not at the 77.5-ft sampling depth.

The VOC concentrations in GSP2-1 are generally lower than in the other gas-monitoring wells, and trends were not plotted for that reason. All detected compounds were below 1,000 parts per billion volume in concentration.

At GSP2-2, analytes occurring at the highest concentrations were 1,1,1-TCA, 1,1-dichloroethane, dichlorodifluoromethane, trichlorofluoromethane, and *cis*-1,2-DCE. The concentration trends for 1,1,1-TCA and 1,1-dichloroethane do not show any consistent trends (Figure 7-8). Dichlorodifluoromethane and trichlorofluoromethane show a trend of increasing concentrations in the 37.5-ft depth sample (Figure 7-8).

At GSP3-1, the compounds occurring at the highest concentrations were 1,1,1-TCA, dichlorodifluoromethane, trichlorofluoromethane, and 1,1-DCE. The concentration plots for 1,1,1-TCA and 1,1-DCE indicate a general trend of increasing concentrations at a depth of 77.5 ft (Figure 7-9).

At GSP3-2, the compounds occurring at the highest concentrations were 1,1,1-TCA, trichlorofluoromethane, and dichlorodifluoromethane. The concentration plots for 1,1,1-TCA and trichlorofluoromethane show a modest trend toward increasing concentrations at a depth of 77.5 ft (Figure 7-10).

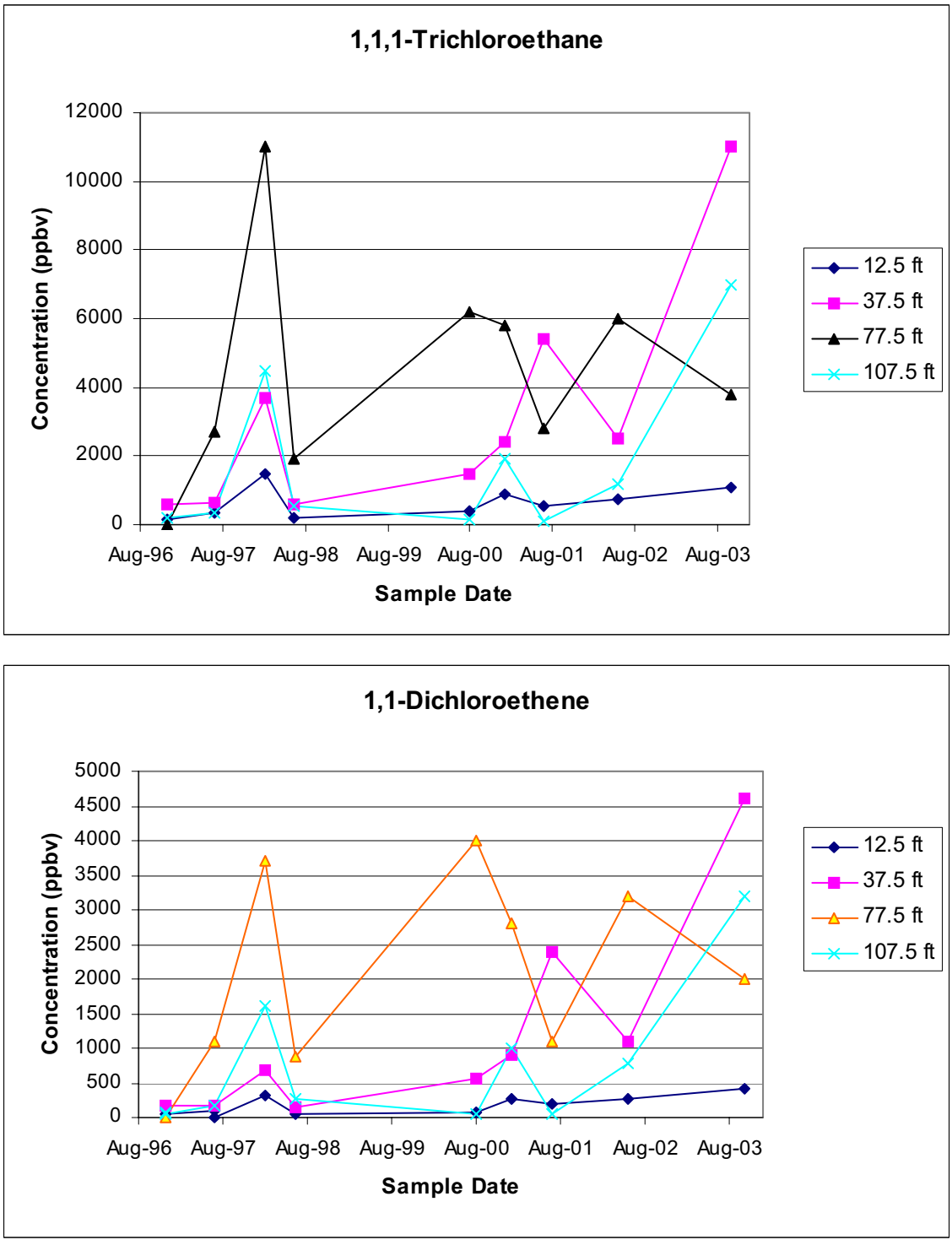
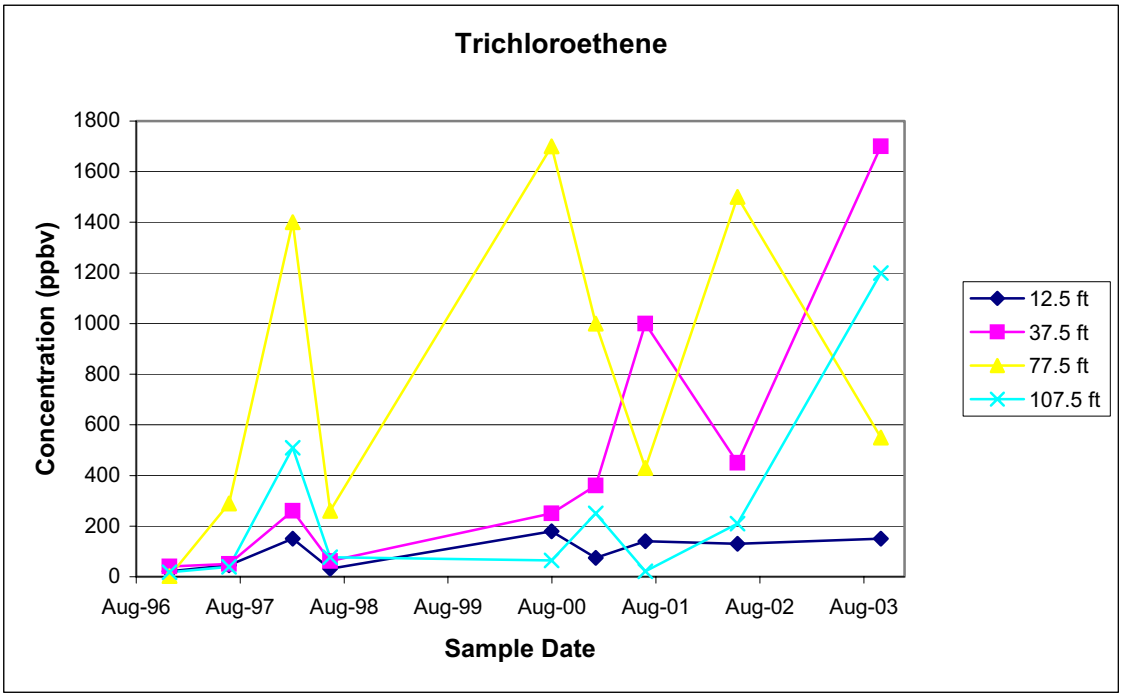


Figure 7-7. Vapor trends for selected compounds in GSP1-1 (CFA-GAS-V-004) at Landfill I.



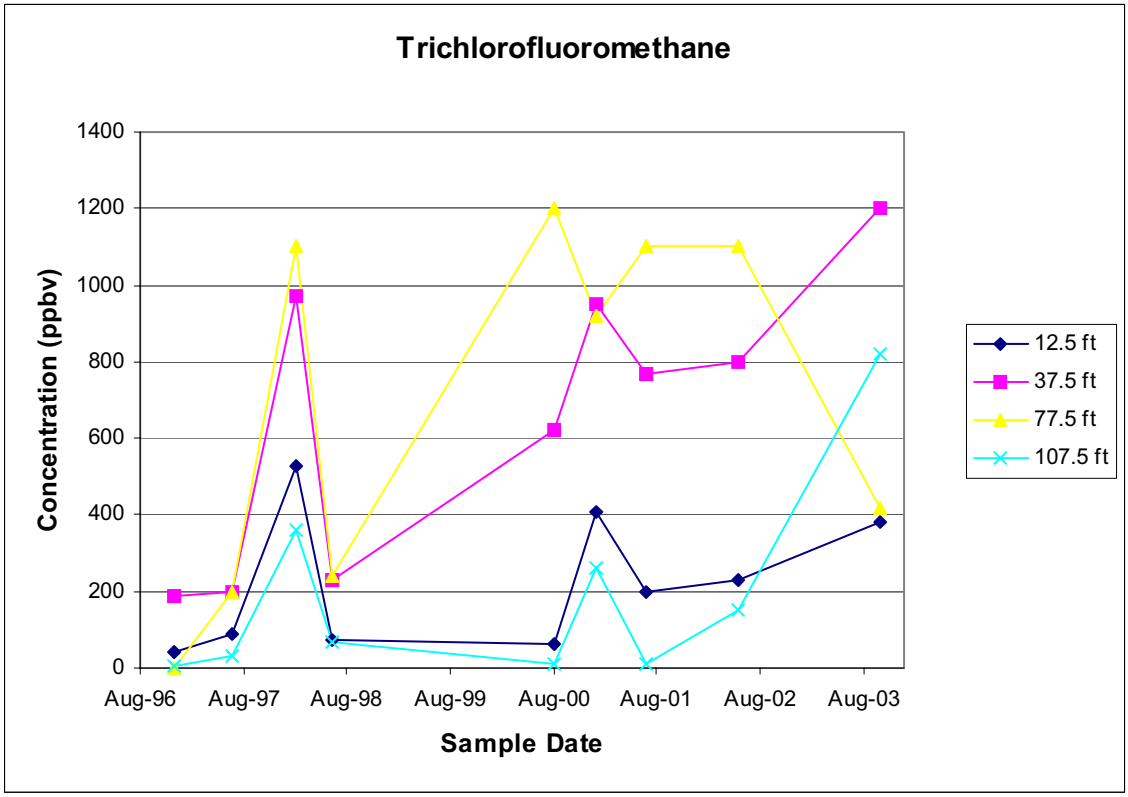
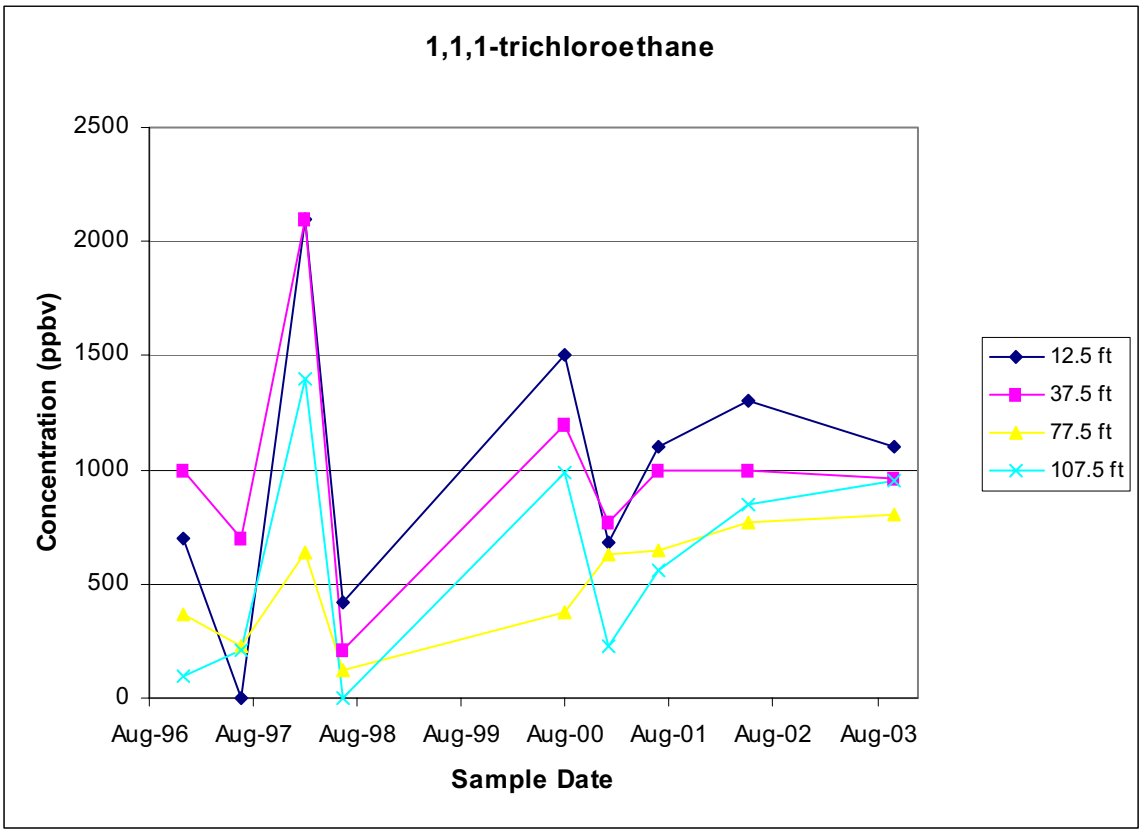


Figure 7-7. (continued).



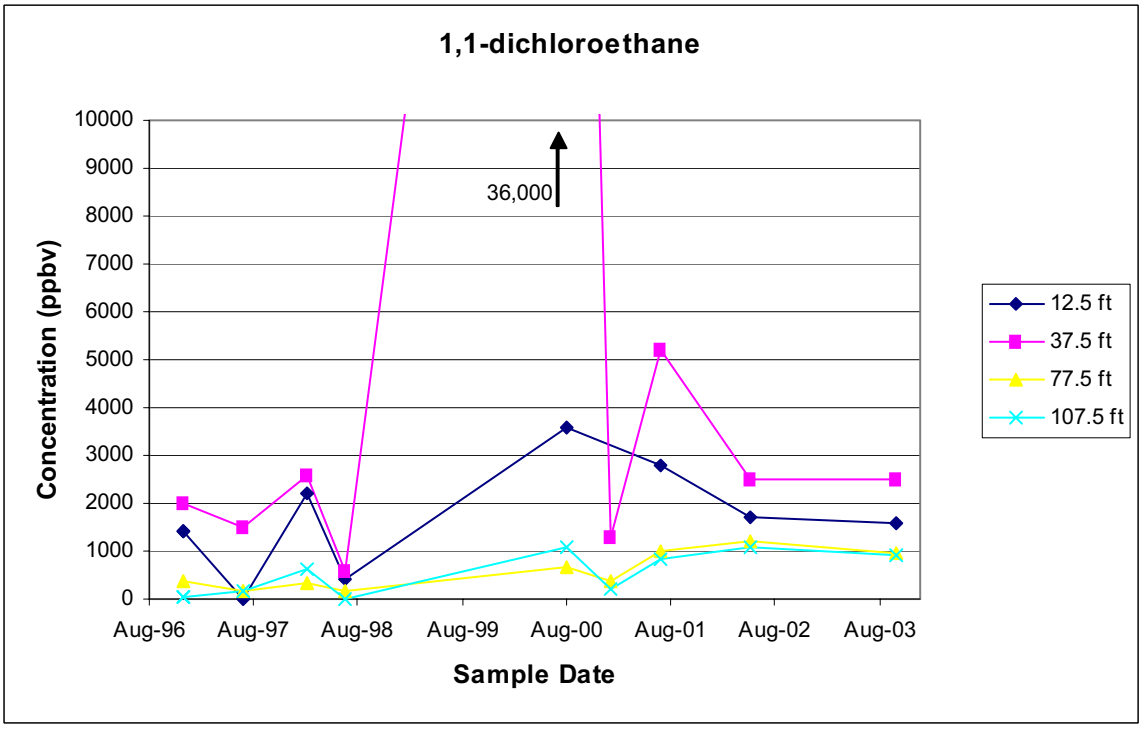
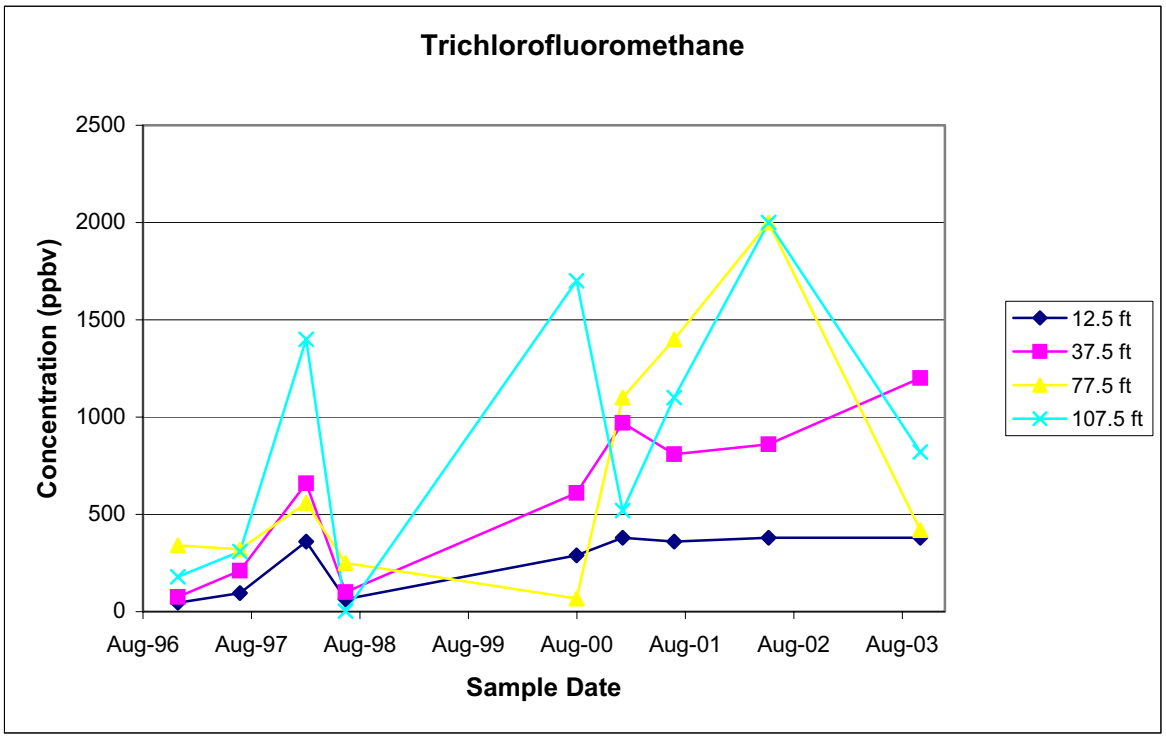


Figure 7-8. Trends for selected compounds at GSP2-2 on Landfill II (CFA-GAS-V-006).



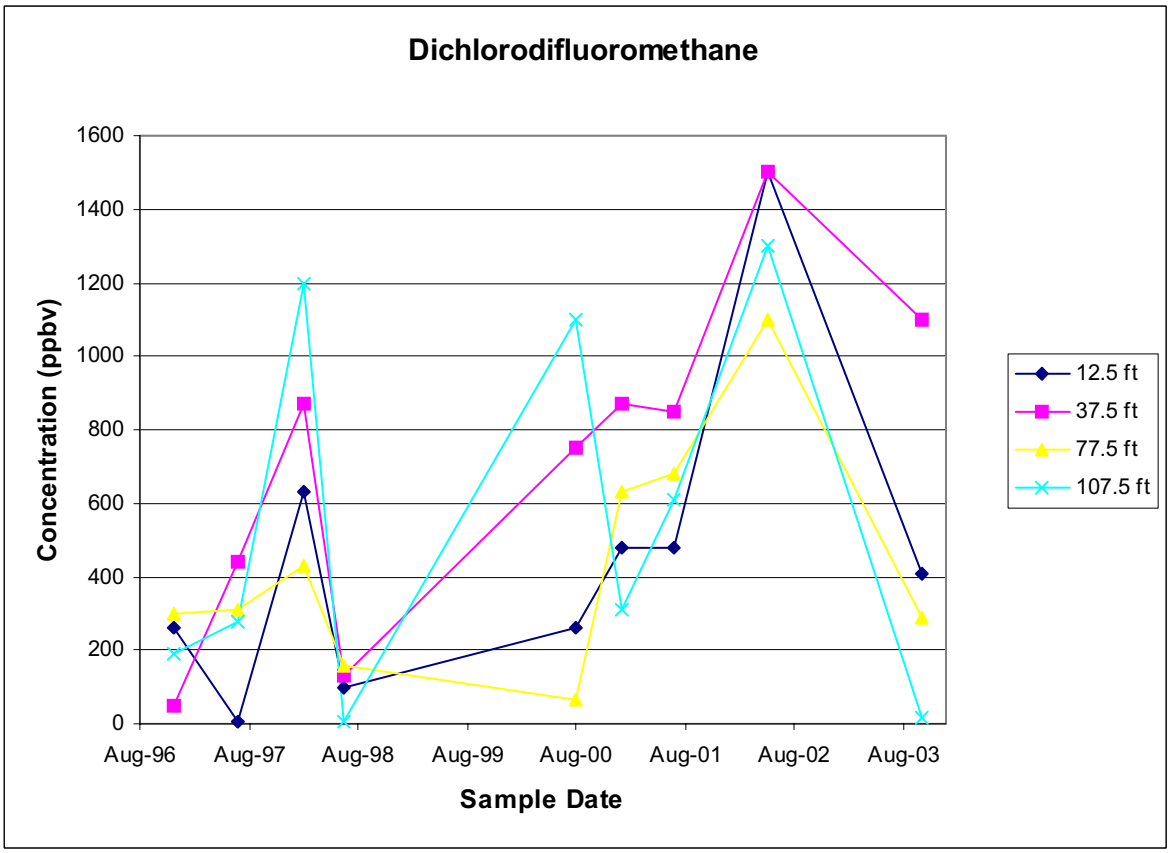
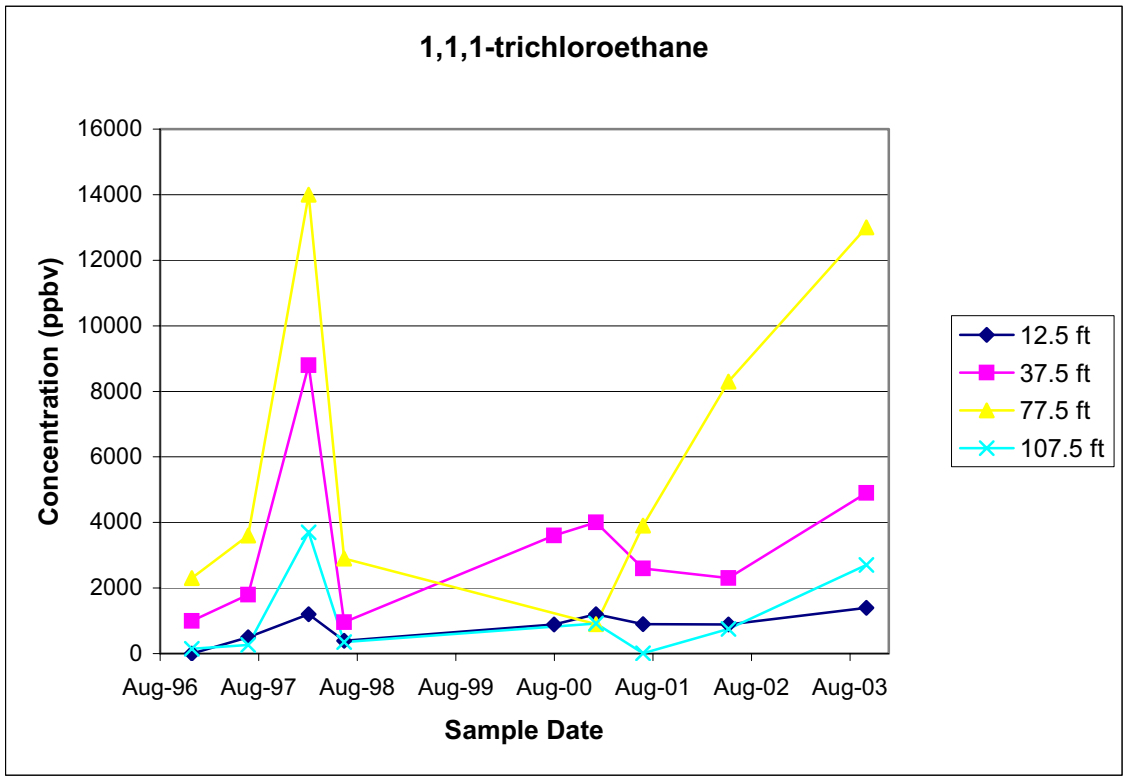


Figure 7-8. (continued).



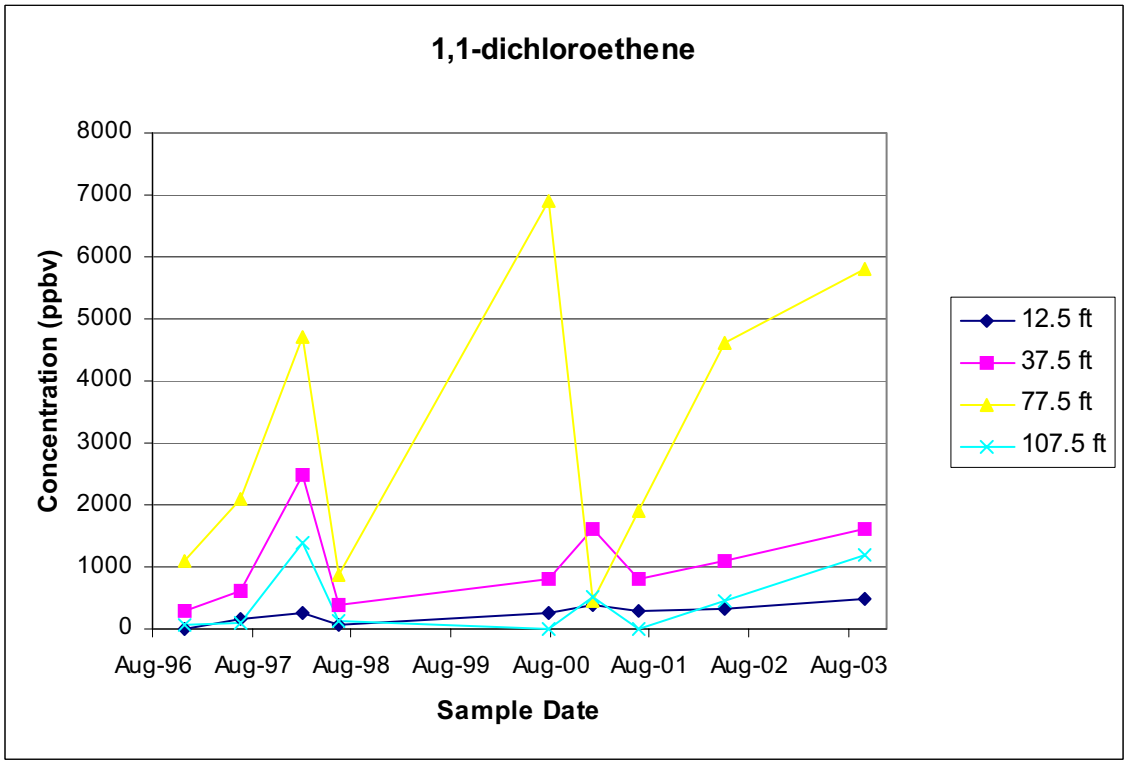


Figure 7-9. Trends for selected compounds at GSP3-1 near Landfill III (CFA-GAS-007).

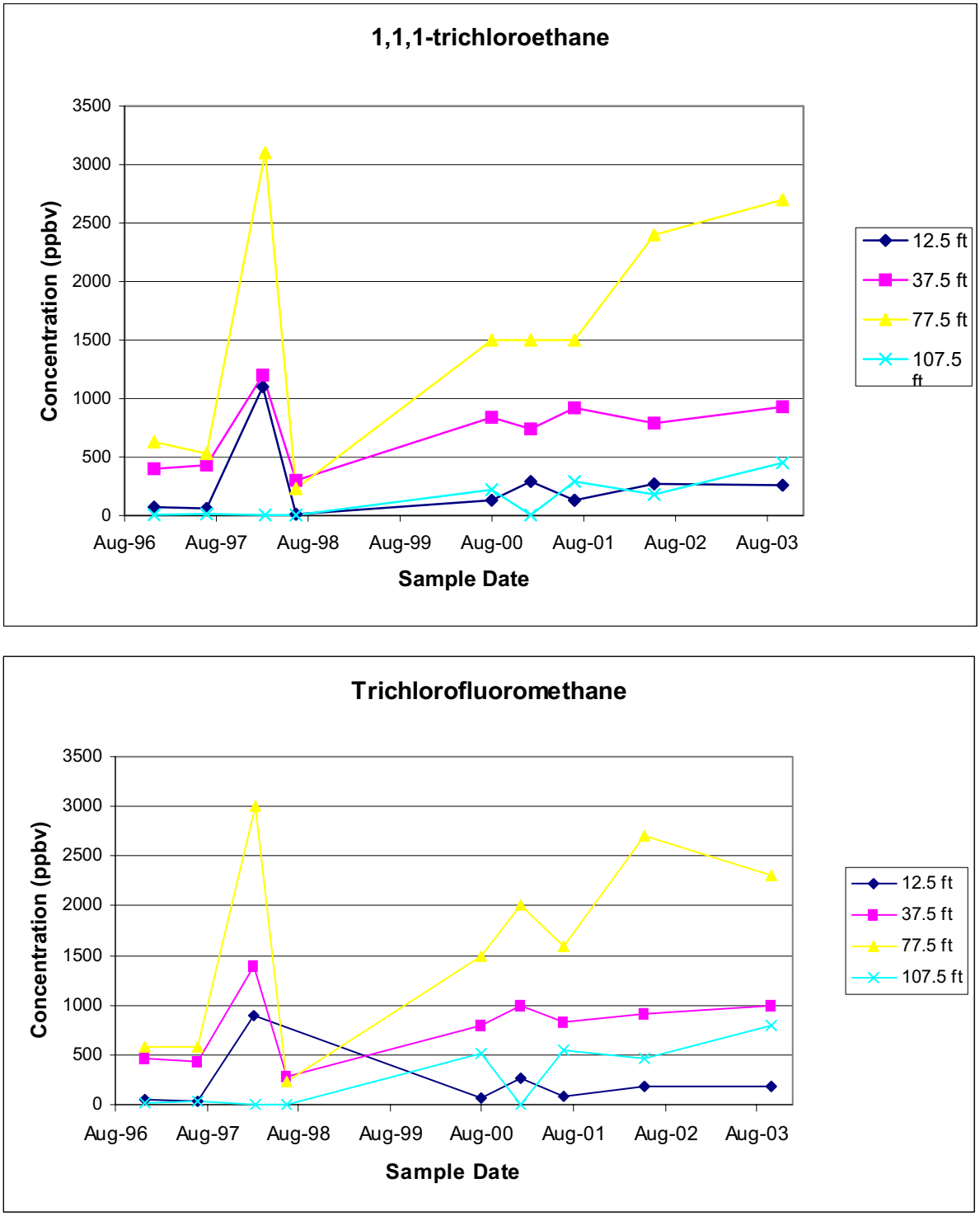


Figure 7-10. Concentration trends for selected compounds at GSP3-2 near Landfill III (CFA-GAS-V-008).

7.2.4 Moisture Monitoring Data Summary

The overall objective of infiltration monitoring at the CFA landfills is to document the effectiveness of the landfill covers for minimizing infiltration into the landfill wastes (INEEL 2003a). The moisture content of the soil was monitored using TDR and neutron-probe instruments. The locations of the TDR arrays and NATs are shown on Figure 7-11.

For the purpose of the data discussion below, water that moves into the soil is defined as "infiltration." Water that continues to move downward below the evapotranspiration (ET) depth of the soil profile is termed "recharge." Infiltration and recharge are represented by an increase in water storage within a system. In addition to recharge, ET is a large contributor to decreasing water content in near-surface soils, moving water upward and out of the soil. The term "drainage" refers to water movement out of a unit thickness of soil or a decrease in soil moisture content but does not indicate the direction of movement. Drainage is used only to evaluate the ET depth. The locations of the soil moisture monitoring locations are shown in Figure 7-3.

7.2.4.1 Neutron Probe Monitoring Summary. The infiltration estimates for the spring of 2002 ranged from 1.34 to 5.23 in., but infiltration ranged from 0.3 to 0.89 in. for the spring of 2003. The infiltration estimates are generally consistent with the measured precipitation of 2.63 in. in 2002 and 1.5 in. in 2003 at the National Oceanic and Atmospheric Administration (NOAA) weather station located at CFA.

The neutron probe data from 2002 and 2003 indicate considerable variability in recharge from year to year (Table 7-5). In 2003, recharge was very low or nonexistent, with recharge estimates for the spring of 2003 less than 0.25 in. for all locations, including the background location. Recharge for the spring of 2002 was greater than 1 in. at four of the five NAT locations.

Changes in storage refer to changes in soil moisture content over a period that represents a full moisture cycle (typically one year). Changes in storage for FY 2002 and FY 2003 are discussed. Changes in storage at the NAT locations for FY 2002 (i.e., October 2001 to October 2002) indicate the moisture content over the soil profile monitored by the NATs at all locations except LF3-05 increased in moisture content (Table 7-5). However, the change in water storage indicates that moisture contents are generally holding steady within the landfill caps and within the ET zones. Location LF2-07 showed the largest increase in water storage, with 1.10 in. over the entire soil column and 1.05 in. below the ET zone. In contrast, LF2-03 located near the edge of Landfill II, showed almost no change in storage over the entire soil column, within and below the ET zone (see Table 7-5). The NATs, LF2-04 and LF3-03, showed small positive changes in storage over the entire soil column and below the ET zone. Changes in storage at the NAT locations during FY 2003 (i.e., October 2002 to October 2003) indicate the moisture content over the soil profile monitored by the NATs decreased at all locations (Table 7-5). The change in water storage indicates that moisture contents decreased slightly within the landfill caps and the ET zones (net drainage).

7.2.4.2 Time-Domain Reflectometer Monitoring Summary. Two deep TDR arrays were installed on Landfills II and III to evaluate infiltration through the cover, evaluate the ET depth, and ascertain recharge below the ET depth (Figure 7-11). Infiltration, recharge, and changes in storage are addressed for the four TDR locations for FY 2002 and FY 2003.

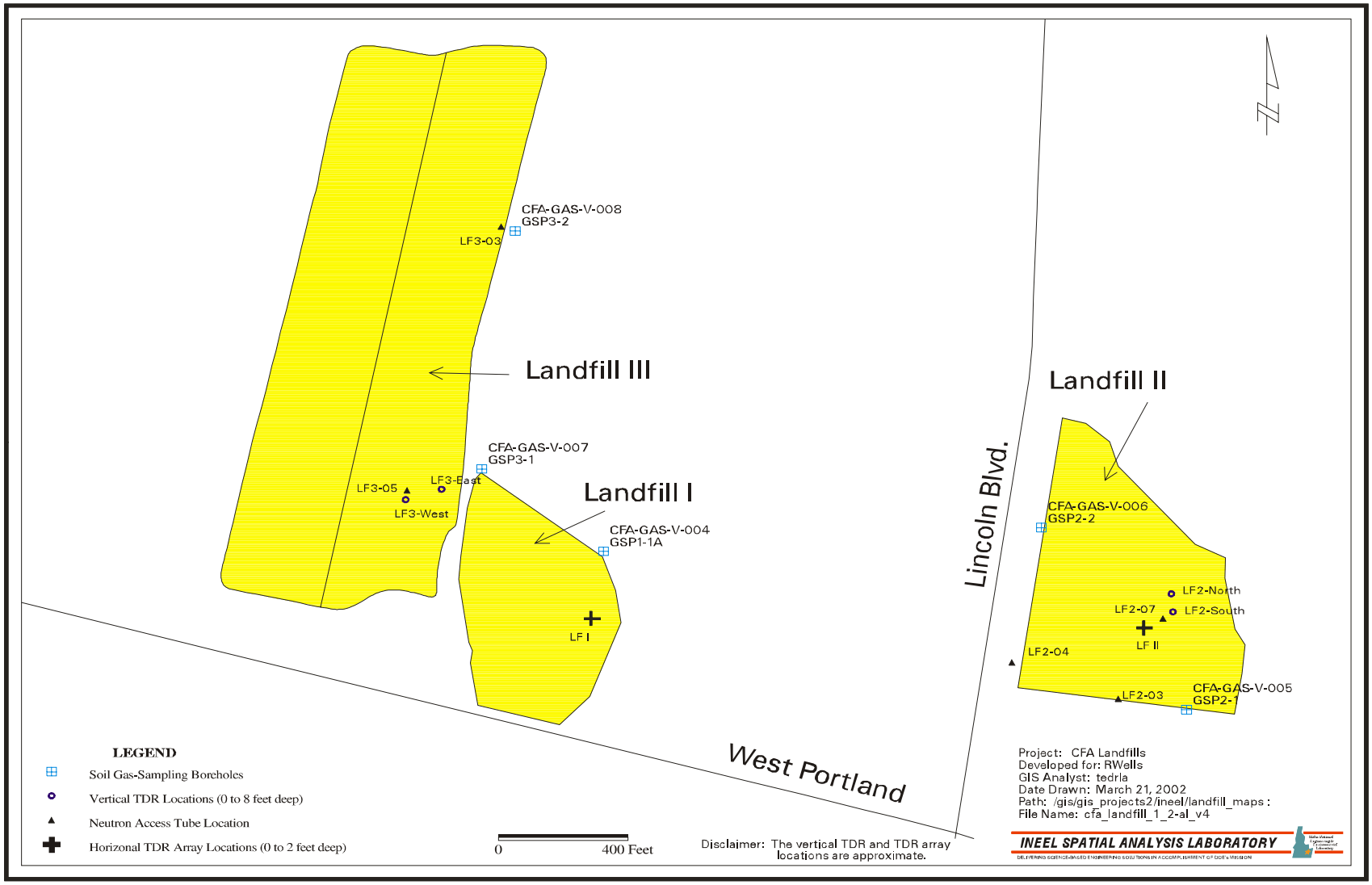


Figure 7-11. Locations of TDR arrays and NATs.

Table 7-5. Summary of moisture monitoring results since previous five-year review.

	NATs					TDRs			
	LF2-03	LF2-04	LF2-07	LF3-03	LF3-05	LF3-east	LF3-west	LF2-north	LF2-south
Infiltration and Recharge Estimates									
Spring 2002 infiltration (in.)									
Infiltration	2.11	2.46	5.23	3.77	1.34	5.35	4.72	4.32	0.81
Recharge[a]	0.29	1.07	2.97	1.24	<0.25	<0.25	<0.25	<0.25	<0.25
Spring 2003 infiltration (in.)									
Infiltration	0.30	0.45	0.42	0.89	0.47	1.91	1.84	1.5	1.05
Recharge[a]	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.28(3)	<0.25
Water Storage Analysis									
Change in storage from 10/01 to 10/02 (in.)									
Total	0.17	0.49	1.10	0.51	-0.42	0.87	-0.13	-0.03	-0.23
Within Cap	—	—	-0.18	0.07	-0.14	-0.17	-0.04	-0.08	-0.22
Within ET Zone	0.02	-0.05	0.05	0.10	-0.18	1.1	-0.09	0.00	-0.27
Below ET Zone	0.15	0.54	1.05	0.41	-0.24	-0.23	-0.04	-0.03	0.04
Change in storage from 10/02 to 10/03 (in. of water)									
Total	-0.30	-0.65	-1.41	-0.46	-0.17	-0.12	-0.67	0.25	0.27
Within Cap	—	—	-0.06	-0.08	-0.17	-0.36	-0.25	-0.14	0.01
Within ET Zone	-0.09	-0.01	-0.30	-0.08	-0.01	0.11	-0.45	-0.18	0.08
Below ET Zone	-0.21	-0.64	-1.11	-0.38	-0.16	-0.23	-0.22	0.42	0.19

a. The ET depth is assumed to be 3 to 4 ft for the NATs and 4 ft for the TDRs. The amount of recharge is estimated to be the increase in moisture content below the ET depth.

Infiltration and recharge calculations for FY 2002 and FY 2003 are based on the amount of infiltration and recharge during the spring, because continuous monitoring of the TDRs indicates that this is the only time during the year that significant moisture moved into the soil. Infiltration calculations for the spring of 2002 and 2003 showed that the TDR results are greater than the 2.63 in. (2002) and 1.5 in. (2003) of precipitation measured at the NOAA weather station (Table 7-5). The discrepancy between measured precipitation at the NOAA weather station and infiltration could be attributed to calibration problems or to physical nonconformities, such as void spaces, next to the probes. However, the TDR data indicated that recharge was minimal, less than 0.25 in., at all TDR locations in 2002 and 2003, except at LF2-North, where recharge was 0.28 in.

The four deep TDRs showed little change in storage over the monitoring period for the 0- to 2-ft and 0- to 8-ft depth intervals for the landfill caps during both FY 2002 and FY 2003 (Table 7-5). At CFA Landfills II and III, from depths of 4 to 8 ft or below the estimated ET depth of 4 ft, there was essentially no change in storage in both 2002 and 2003. There was little change in storage over the monitoring period for the 0- to 2-ft depth intervals for the landfill caps at the four TDR locations in both 2002 and 2003 (Table 7-5). In FY 2002, three of the four TDR locations showed a loss in storage for the 0- to 8-ft depth interval over the monitoring period (Table 7-5). In 2003, the two TDR locations at Landfill III showed a loss in storage for the 0- to 8-ft depth interval over the monitoring period, while the two TDRs at Landfill II showed a slight gain (Table 7-5).

7.2.5 Summary of CFA Landfill Monitoring Results

Groundwater monitoring indicates that nitrate is the only constituent to exceed a groundwater MCL since the last five-year review. Over time, plots of nitrate concentrations in Wells CFA-MON-A-002 and -003 show that the concentrations are remaining steady. A reevaluation of the nitrate source using nitrogen and oxygen isotope ratios in nitrate and water-level data indicated that the nitrate source was probably the dry pond (Site CFA-04).

The most common VOCs detected in the soil-gas samples consisted of the halogenated compounds 1,1,1-TCA, 1,1-dichloroethane, 1,1-DCE, TCE, dichlorodifluoromethane, and trichlorofluoromethane. These are common solvents, constituents found in solvents, or freons. Other solvents detected in the soil-gas samples included F-113, F-114, carbon tetrachloride, and PCE. *Cis*-1,2-DCE was also detected and frequently occurs as a result of the anaerobic degradation of chlorinated ethenes like TCE and PCE. None of these VOCs was detected in groundwater.

Moisture monitoring results from TDR and NAT data indicate variable recharge related to the amount of winter precipitation. The calculated infiltration amounts for the TDRs are higher than the values determined from the NAT data.

7.3 Progress since Last Review

The last five-year review of CFA Landfills I, II, and III (i.e., OU 4-12) was completed in November 2002 (DOE-ID 2002d). The remedial actions at the mercury pond (Site CFA-04), the sewage plant drainfield (Site CFA-08), and the transformer yard (CFA-10) were completed in 2003, 2002, and 2001, respectively, but those sites (i.e., OU 4-13) have not been the subject of a five-year review until now.

As part of the first five-year review for OU 4-12, the determination as to whether the remedial action implemented for CFA Landfills I, II, and III is protective of human health and the environment was deferred until additional assessments of groundwater-level data and landfill cover performance could be completed. Based on the assessment, recommendations were made that would aid in the assessment of the effectiveness of the remedial action at the CFA landfills. The recommendations and actions taken since the previous five-year review for OU 4-12 are summarized in Table 7-6.

7.4 Technical Assessment

The information provided in this technical assessment is a summary of previously compiled data on the operations, maintenance, and monitoring activities associated with Sites CFA-01, -02, -03, -04, -08, and -10.

7.4.1 CFA Landfills I, II, and III (Sites CFA-01, -02, and -03)

This assessment evaluates the monitoring data collected in support of the remedial action for the CFA landfills, as summarized in Subsection 7.2. Additionally, the assessment considers information obtained from the annual institutional control inspections and operation and maintenance of the covers at the CFA landfills.

Question A: *Is the remedy functioning as intended by the decision documents?*

The landfill covers were intended to prevent direct contact with landfill contents and prevent water from percolating through the landfills and carrying contaminants from the waste into the SRPA. The soil

Table 7-6. Recommendations and responses to issues from the first five-year review for OU 4-12.

Recommendation in first five-year review	Action taken
Continue the yearly inspection of the institutional controls.	Completed
Continue annual groundwater sampling.	Completed
Continue annual soil-gas monitoring, and change it from October to September.	Completed
Continue to monitor USGS-083 and LF3-09	Completed
Continue monthly moisture monitoring through September 2003.	Completed
Perform digital gyroscopic deviation surveys.	Completed on selected wells
Defer decision as to whether an additional well is required to monitor groundwater under the CFA landfills until new groundwater contour maps are derived.	Two additional wells have been installed during FY 2005. Well placement was based on revised groundwater contour maps.
Monitor detectable vapor analytes (i.e., VOCs) in the groundwater.	Contract Laboratory Program VOCs continue to be the target analytes for groundwater sampling.
Reevaluate the source of nitrates.	Sampling for nitrogen and oxygen isotope ratios in nitrate was completed, and new groundwater contour maps were generated.
Submit non-quality-assured data (i.e., groundwater elevations, NAT data, and TDR data) as part of the annual monitoring reports.	Completed

gas monitoring points, moisture infiltration equipment, and groundwater monitoring wells were installed in strategic locations to evaluate impacts to the environment (SRPA) from the waste in the landfills. Based on the review of the available data, the landfill covers continue to function as designed by limiting the amount of infiltration at the surface of the landfills.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

There have been no changes in the original exposure assumptions, toxicity data, cleanup levels, or RAOs since completion of the covers at CFA Landfills I, II, and III. The groundwater monitoring results have shown that concentrations of nitrates exceeding the MCLs for drinking water are not attributed to the leaching of contaminants from the landfills. The original assumptions, cleanup levels, and RAOs used at the time of the remedy are still valid, based on the review of the technical assessment data provided.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

The soil-gas, groundwater, and soil-moisture (TDR and NAT) data and observations from annual operations and maintenance inspections have been reviewed. Two items of interest were identified for further evaluation as part of this five-year review: (1) the potential impact of soil-gas VOCs on groundwater at the CFA landfills and (2) the appearance of subsidence in the cover of Landfill III (Figure 7-2). In addition, it is noted that during past installation of the TDR arrays, roots were observed encroaching into the low-permeability layer of the landfill covers.

A preliminary evaluation of the potential impacts of VOCs in soil gas at the CFA landfills was made by comparing deep soil-gas concentrations at the CFA landfills to the preliminary remediation goals calculated for the Subsurface Disposal Area at the Radioactive Waste Management Complex. Using the 2003 soil-gas data, the maximum PCE, TCE, and 1,1,1-TCA concentrations measured at the CFA landfills are much lower than the preliminary remediation goals calculated for the Subsurface Disposal Area (ICP 2004a). Given these comparisons, it is highly unlikely that contamination from the CFA landfills would adversely impact the SRPA.

Although the subsidence at Landfill III has potentially compromised the integrity of the cover, the cover integrity will be restored upon repair, thus reestablishing the protectiveness of the remedy. In addition, it is uncertain what effect encroachment of roots into the low-permeability layer of the landfill covers may have on the protectiveness of the remedy. Therefore, infiltration monitoring should continue, and alternative vegetation analysis and infiltration modeling will be performed in FY 2006 to evaluate the impacts of root encroachment into the low-permeability layer of the landfill covers. Soil-gas and groundwater data will continue to be monitored to assess the protectiveness of the remedy. The covers at CFA Landfills I, II, and III remain protective of human health and the environment, and there is no additional information that indicates that the protectiveness of the covers has been compromised.

7.4.2 Mercury Pond (Site CFA-04)

This assessment evaluates the protectiveness of the remedial action implemented at the mercury pond. As stated previously, this remedial action was completed in November 2003 through the removal and disposal of mercury-contaminated soil that exceeded the prescribed remedial action goal (DOE-ID 2004a).

Question A: *Is the remedy functioning as intended by the decision documents?*

The selected remedy at the mercury pond included the excavation, removal, and disposal of mercury-contaminated soil. Additionally, material that contained asbestos was removed and disposed of. The remedial activities removed, to the extent practical, all mercury-contaminated media that exceeded the remedial action goal concentration of 8.4 mg/kg (DOE-ID 2000b; DOE-ID 2003b). The average concentration in the pond area is 7.3 mg/kg, which is below the 8.4-mg/kg remedial action goal (DOE-ID 2004a).

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

There have been no changes to the original exposure assumptions, toxicity data, cleanup levels, or RAOs since the remedial action was completed. Upon completion of the remedial action, the average mercury concentration in the soil in the pond area was 7.3 mg/kg. As such, the excess risk to human or ecological receptors from the residual mercury contamination is determined to be within acceptable limits.

The ESD to the ROD provided justification to raise the remedial action goal from 0.5 mg/kg to 8.4 mg/kg, based on updated mercury toxicity data (DOE-ID 2003b). Originally, the mercury pond was not identified as presenting a risk to the SRPA, based on information provided in the RI/FS (DOE-ID 2000a); however, the mercury pond has recently been identified as a potential source for the elevated nitrate concentrations in two monitoring wells south of CFA (ICP 2004a).

More information is needed on the types and quantities of nitrate disposed of in the pond. As a result, the source of nitrates will continue to be investigated until it can be positively identified or the nitrate levels drop below the MCL.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

Because the remedial action was completed in November 2003 and the contaminated soil was removed from the site, the remedy is considered to be protective of human health and the environment; however, the recent suggestion that the mercury pond might be the source of elevated nitrates in the groundwater reaffirms the need for continued groundwater monitoring in and around CFA to assess the concentrations of contaminants in the SRPA.

7.4.3 Sewage Plant Drainfield (Site CFA-08)

Question A: *Is the remedy functioning as intended by the decision documents?*

The intent of the engineered cover placed over the sewage plant drainfield was to prevent human or ecological receptor contact with the radioactively contaminated (Cs-137) materials in the drainfield. The remedial action, including installation of institutional controls, was completed at the site in November 2002 and has been the subject of annual operations, maintenance, and institutional control inspections. Based on the results of these inspections, the remedy is functioning as intended by the decision documents.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

There have been no changes to the original exposure assumptions, toxicity data, cleanup levels, or RAOs since the remedial action was completed. As such, the original assumptions are still considered valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

Nitrate concentrations in excess of the EPA drinking water standard of 10 mg-N/L have been detected in two of the CFA groundwater monitoring wells (ICP 2004a). A nitrogen isotope study completed in 2000 implicated the sewage plant drainfield as the source of the elevated nitrates (INEEL 2002); however, the revised groundwater flow map in the 2002 annual monitoring report (INEEL 2003b) and a new nitrogen and oxygen isotope study (ICP 2004a) did not support the drainfield as the source of the nitrates. Both the revised water level map and the nitrogen and oxygen isotope study indicated that the mercury pond (Site CFA-04) was the probable source of the nitrates. The engineered cover and institutional controls remain protective of human health and the environment.

7.4.4 Transformer Yard (Site Code CFA-10)

Question A: *Is the remedy functioning as intended by the decision documents?*

The remedy at the transformer yard included the removal and disposal of lead-contaminated soil. The verification sampling performed after completion of the soil removal indicates that the lead concentration in the soil ranges from 9.7 to 298 mg/kg, well below the remedial action goal of 400 mg/kg.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

There have been no changes to the original exposure assumptions, toxicity data, cleanup levels, or RAOs since completion of the remedial action. As such, the original assumptions are still considered valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

There has been no new information that would indicate that the remedy is not protective. All contaminated media with lead concentrations exceeding the remedial action goal of 400 mg/kg were removed from the site, thereby removing the potential for exposure of human and ecological receptors to contamination that would present unacceptable risk or hazards.

7.5 Technical Assessment Summary

CFA Landfills I, II, and III (Sites CFA-01,-02 and -03) were capped with engineered covers. The covers are performing as expected by limiting infiltration from the surface, and indications are that the remedy is effective.

The sewage plant drainfield (Site CFA-08) had been suspected of being a nitrate source, as indicated by nitrate levels found in CFA monitoring wells. However, nitrogen and oxygen isotope ratios in nitrate showed that this was not the most likely source of the nitrates. The drainfield was capped with an engineered cover to prevent human and receptor contact with radioactive contaminants.

The mercury pond (Site CFA-04) has now been identified as a possible source of the increased nitrate levels in Wells CFA-MON-A-002 and -003. The pond was remediated by removing contaminated soil. Though the pond has been remediated, contaminants have migrated into the vadose zone, and groundwater monitoring will need to continue to track the nitrate contamination.

7.6 Issues

No issues were identified with the mercury pond (Site CFA-04), the French drains (Site CFA-07), the sewage plant drainfield (Site CFA-08), or the transformer yard (CFA-10).

The subsidence feature identified on CFA Landfill III (Site CFA-03) compromised the integrity of the cover and, if the cover is not repaired, has the potential to allow surface water to contact the waste and potentially carry contaminants to the SRPA.

7.7 Recommendations and Follow-up Actions

Recommendations are made in this subsection relating to the sites that are subject to a five-year review—specifically, CFA Landfills I, II, and III (Sites CFA-01, -02, and -03), the French drains (Site CFA-07), and the sewage plant drainfield CFA-08—as specified in the OU 4-13 operations and maintenance plan (DOE-ID 2002b).

The subsidence feature in the cover of Landfill III (Site CFA-03) will be repaired and revegetated in accordance with the original cover design and construction. To this end, it is recommended that the annual visual inspections of the landfills continue, paying close attention to the repaired portion of Landfill III. These inspections will continue until the next five-year review, when continuation of the inspections will be reevaluated. In accordance with the OU 4-13 operations and maintenance plan, a topographical survey of Landfills I, II, and III will also be performed in FY 2005. Additionally, the repaired area of Landfill III will be the subject of topographical surveys in FY 2006 and FY 2007 to evaluate and document the effectiveness of repairing the subsidence. Topographical surveys will be conducted for subsequent five-year reviews, and the frequency of the surveys will be evaluated.

Because VOCs have been detected in the past in the groundwater and in the gas vapors, it is recommended that the soil-gas sampling continue at the CFA Landfills I, II, and III on an annual basis. "Trigger" soil-gas concentrations should be calculated to determine the need for vadose zone vapor modeling. Upon determination of the "trigger" concentrations, continuation of the vapor sampling at the CFA landfills will be reevaluated through the comparison of the "trigger" soil-gas concentrations to the historical vapor concentrations observed from the sampling events at the CFA landfills. The VOCs will continue to be monitored in the groundwater and would indicate any future vertical migration.

7.8 Protectiveness Statement

Based on the data reviewed and the site inspections, the remedies are functioning as intended by the OU 4-12 ROD (DOE-ID 1995) and the OU 4-13 ROD (DOE-ID 2000b), as modified by the ESD (DOE-ID 2003b). No changes in the physical conditions of the site have occurred that would affect the protectiveness of the remedies. There have been no changes in the toxicity factors or risk factors for the COCs. Several issues have been identified that warrant further evaluation; however, there is no information that negates the protectiveness of the remedies at the WAG 4 sites at this time.

7.9 Section 7 References

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8. WASTE AREA GROUP 5 (AUXILIARY REACTOR AREA AND POWER BURST FACILITY)

Waste Area Group (WAG) 5 comprises the Auxiliary Reactor Area (ARA) and the Power Burst Facility (PBF).

ARA consisted of four separate operational areas (designated as ARA-I, -II, -III, and -IV). The ARA-II facility housed the Stationary Low Power Reactor No. 1 (SL-1) facility and numerous minor structures. The ARA-I facility was built to support SL-1. Both of these facilities were built in 1957. In 1961, an accident destroyed the SL-1 reactor, and ARA-I became the staging area for the SL-1 emergency response and subsequent SL-1 decontamination and cleanup.

ARA-III and -IV were built in the late 1950s. The ARA-III facility initially housed the Army Gas-Cooled Reactor Experiment research reactor, and the ARA-IV facility was built to accommodate the Mobile Low Power Reactor-1. Experiments with the Army Gas-Cooled Reactor were discontinued at ARA-III in 1961. Work on the Mobile Low Power Reactor-1 at ARA-IV continued through 1964. In 1963, the ARA-III facility was modified to support tests at ARA-IV and remained active until 1965. ARA-IV was used to operate the Nuclear Effects Reactor Program from 1967 to 1970. ARA-IV is still in use as part of the Critical Infrastructure Test Range Complex.

PBF was built in the late 1950s. Initially, it was known as the Special Power Excursion Reactor Test (SPERT) facility and consisted of five separate operational areas: the Control Area and SPERT-I, -II, -III, and -IV. Later, operational areas at PBF consisted of the PBF Control Area, the PBF Reactor Area (SPERT-I), the Waste Engineering Development Facility (SPERT-II), the Waste Experimental Reduction Facility (SPERT-III), and the Mixed Waste Storage Facility (SPERT-IV). Collectively, the Waste Engineering Development Facility, the Waste Experimental Reduction Facility, and the Mixed Waste Storage Facility were known as the Waste Reduction Operations Complex.

Operations at ARA and PBF resulted in releases of contaminants to the environment. Consequently, these areas have been designated as WAG 5 under a federal facilities agreement and consent order (FFA/CO) (DOE-ID 1991). This Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601 et seq.) remedial action is proceeding in accordance with requirements identified in four records of decision (RODs). Tables 8-1 through 8-3 list the release sites that required remediation, the contaminants of concern (COCs) at each site, and the cleanup goals for each site. Figures 8-1 and 8-2 show the CERCLA sites at ARA and PBF, respectively.

The first ROD, issued in September 1992, focused on remediation of the PBF corrosive waste sump (Site PBF-08) and evaporation pond (Site PBF-10) within Operable Unit (OU) 5-13 as part of an interim remedial action (INEL 1992a). The second ROD, issued in December 1992, focused on the no-action declaration for the ARA-I chemical evaporation pond (Site ARA-01) (INEL 1992b). The third ROD was issued in January 1996 under OU 5-07 and focused on remediation of the SL-1 burial ground (Site ARA-06) and the identification of 10 no-action sites within OUs 5-01, 5-03, 5-04, and 5-11 (and an additional burial ground within WAG 6, OU 6-01, that is not summarized here) (INEL 1996). Although no additional effort was expended to remediate or assess these no-action sites individually, each was considered for cumulative effects in the comprehensive remedial investigation/feasibility study (RI/FS) for WAG 5. The fourth ROD, also known as the comprehensive ROD for WAG 5 (OU 5-12), was issued in January 2000 and describes the proposed remedial action for WAG 5 sites not covered by the previous RODs (DOE-ID 2000a).

Table 8-1. COCs at WAG 5.

Site (Site Code)	COC	Remediation Goal
PBF Corrosive Waste Sump (PBF-08)	Cs-137	30 pCi/g
	Chromium	800 mg/kg
PBF Evaporation Pond (PBF-10)	Cs-137	30 pCi/g
	Chromium	800 mg/kg
SPERT-II Leach Pond (PBF-16)	Mercury	0.5 mg/kg
Contaminated Soil beneath PER-751 Pump House Floor Slab and Foundation (PBF-37)	Cs-137	23 pCi/g
ARA-I Chemical Evaporation Pond (ARA-01)	Arsenic	10 mg/kg
	Selenium	2.2 mg/kg
	Thallium	4.3 mg/kg
ARA-I Sanitary Waste System (ARA-02)	Cs-137	8.5 pCi/g[a]
	Ra-226	2.1 or 1.2 pCi/g[b]
	U-235	6.2 pCi/g[a]
	U-238	10.6 pCi/g[a]
	Aroclor-1242	1 mg/kg[c]
	Lead	400 mg/kg
ARA-II Stationary Low-Power Reactor No. 1 Burial Ground (ARA-06)	Refer to Tables 8-2 and 8-3	Inhibit exposure to radioactive constituents
ARA-III Radioactive Waste Leach Pond (ARA-12)	Ag-108m	0.75 pCi/g
	Copper	220 mg/kg
	Mercury	0.5 mg/kg
	Selenium	2.2 mg/kg
ARA-I Radionuclide Tank (ARA-16)	Cs-137	23 pCi/g
Radiologically Contaminated Surface Soils and Subsurface Structures Associated with ARA-I and ARA-II (ARA-23)	Cs-137	23 pCi/g
ARA-I Soil beneath the ARA-626 Hot Cells (ARA-25)	Cs-137	23 pCi/g
	Ra-226	2.1 or 1.2 pCi/g[b]
	Arsenic	5.8 mg/kg
	Lead	400 mg/kg
	Copper	220 mg/kg

a. The remediation goals for Cs-137, U-235, and U-238 are weighted averages based on relative risk contributions and 100 times the 1E-06 risk-based soil concentrations reported by Fromm (1996). The cumulative risk for Cs-137, U-235, and U-238 is 1E-04 at the remediation goal soil concentrations.

b. The remediation goal is the average Idaho National Laboratory (INL) Site background value for Ra-226 reported by Giles (1998), because the 1E-04 risk-based concentration derived from Fromm (1996), 0.55 pCi/g, is below the INL-average background concentration. A goal of 2.1 pCi/g will be used for comparison of sample results that may include interference from U-235. Otherwise, a goal of 1.2 pCi/g will be used.

c. The reference addresses polychlorinated biphenyl remediation waste for high-occupancy areas. Though the seepage pit sludge is not remediation waste, 1 mg/kg was identified as a protective remediation goal for the aroclor-1242 contained in the seepage pit sludge. A noncarcinogenic risk-based remediation goal could not be developed, because a reference dose for calculating a hazard quotient specific to aroclor-1242 is unavailable. The toxicity of aroclor-1242 was qualitatively assessed using the reference doses for aroclor-1254.

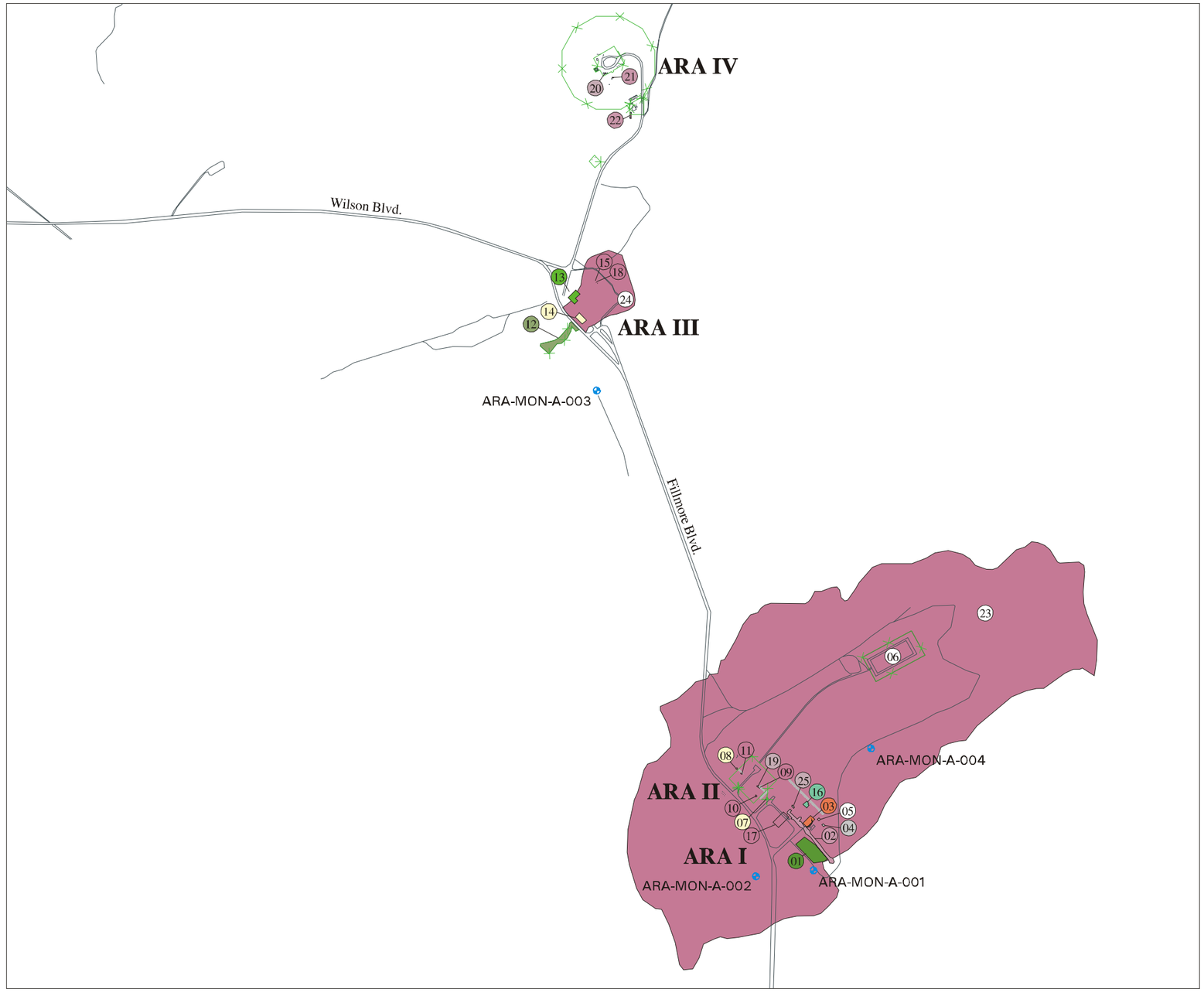
Table 8-2. Surface soil concentrations for various COCs at SL-1.

	Concentration (pCi/g)	
Radionuclide	95% Upper Confidence Limit	INL Background[a]
Co-60	0.36	No data available
Cs-137	904	1.28
Eu-154	2.68	No data available
Sr-90	1370	0.76
Th-230 and/or U-234	2.7	1.88/1.95

a. 95%/95% upper tolerance limit, grab sample background concentrations from *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (Rood et al. 1995).

Table 8-3. Subsurface concentrations for various COCs at SL-1.

	Concentration (pCi/g)	
Radionuclide	July 1994	July 2094 (Anticipated)
Cs-137	2.29E+04	2.27E+03
Sr-90	2.15E+04	1.99E+03
Kr-85	6.91E+02	1.08E+00
Sm-151	5.20E+02	2.41E+02
Pm-147	2.62E+01	8.78E-11
Pu-241	1.96E+01	1.59E-01
Eu-154	1.84E+01	5.80E-03
Eu-155	1.24E+01	1.05E-05
Pu-239	1.04E+01	1.04E+01
Tc-99	6.85E+00	6.85E+00
Pu-238	6.72E+00	3.05E+00
Am-241	2.57E+00	2.76E+00
Pu-240	1.56E+00	I.55E+00
Zr-93	1.04E+00	1.04E+00

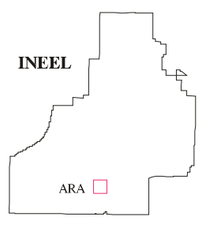


ARA
CERCLA Sites

LEGEND

- Roads and Buildings
- Fences
- Acids
- Acids and Organics
- Acids, Inorganics, and Organics
- Rad
- Organics and Rad
- Inorganics
- Sanitary Waste
- No Known Hazardous Materials
- No Action
- Wells

OPERABLE UNIT	SITE CODE	STATUS	DESCRIPTION
05- 10	ARA- 01	RI/FS	ARA- I Chemical/Evaporation Pond (ARA- 745)]
05- 07	ARA- 02	Track 2	ARA- I Sanitary Waste Leach Field and Seepage Pit (ARA- 746)
05- 07	ARA- 03	Track 2	ARA- I Pad Near ARA- 627 (Lead sheeting)
05- 00	ARA- 04	No Action	ARA- I Sewage Treatment Facility (ARA- 737)
05- 01	ARA- 05	Track 1	ARA- I Evaporation Pond to NE (ARA- 744)
05- 05	ARA- 06	Track 2	ARA- II SL- 1 Burial Ground
05- 00	ARA- 07	No Action	ARA- II Seepage Pit to East (ARA- 720A)
05- 00	ARA- 08	No Action	ARA- II Seepage Pit to West (ARA- 720B)
05- 00	ARA- 09	No Action	ARA- II Septic Tank (ARA- 738)
05- 00	ARA- 10	No Action	ARA- II Septic Tank East (ARA- 613)
05- 00	ARA- 11	No Action	ARA- II Septic Tank West (ARA- 606)
05- 06	ARA- 12	Track 2	ARA- III Radioactive Waste Leach Pond
05- 11	ARA- 13	Track 1	ARA- III Sanitary Sewer Leach Field and Septic Tank (ARA- 740)
05- 00	ARA- 14	No Action	ARA- III Septic Tank and Drainfield (ARA- 739)
05- 01	ARA- 15	Track 1	ARA- III Radionuclide Tank (ARA- 735)
05- 01	ARA- 16	Track 1	ARA- I Radionuclide Tank (ARA- 729)
05- 01	ARA- 17	Track 1	ARA- I Drain (ARA- 626)
05- 01	ARA- 18	Track 1	ARA- III Radionuclide Tank (ARA- 736)
05- 01	ARA- 19	Track 1	ARA- II Detention Tank for Fuel Oil/Radionuclides (ARA- 719)
05- 06	ARA- 20	Track 2	ARA- IV Test Area Contaminated Leach Pit No. 1
05- 00	ARA- 21	No Action	ARA- IV Test Area Septic Tank and Leach Pit No. 2
05- 00	ARA- 22	No Action	ARA- IV Control Area Septic Tank and Leach Pit No. 3 (ARA- 617)
05- 00	ARA- 22	No Action	ARA- IV Control Area Septic Tank and Leach Pit No. 3 (ARA- 617)
05- 12	ARA- 23	Track 1- NSI	ARA Radiologically Contaminated Soil
05- 12	ARA- 24	Track 1- NSI	ARA- III Windblown Contamination Area
05- 12	ARA- 25	RI/FS- NSI	ARA- I Soils Beneath the ARA- 626 Hot Cells



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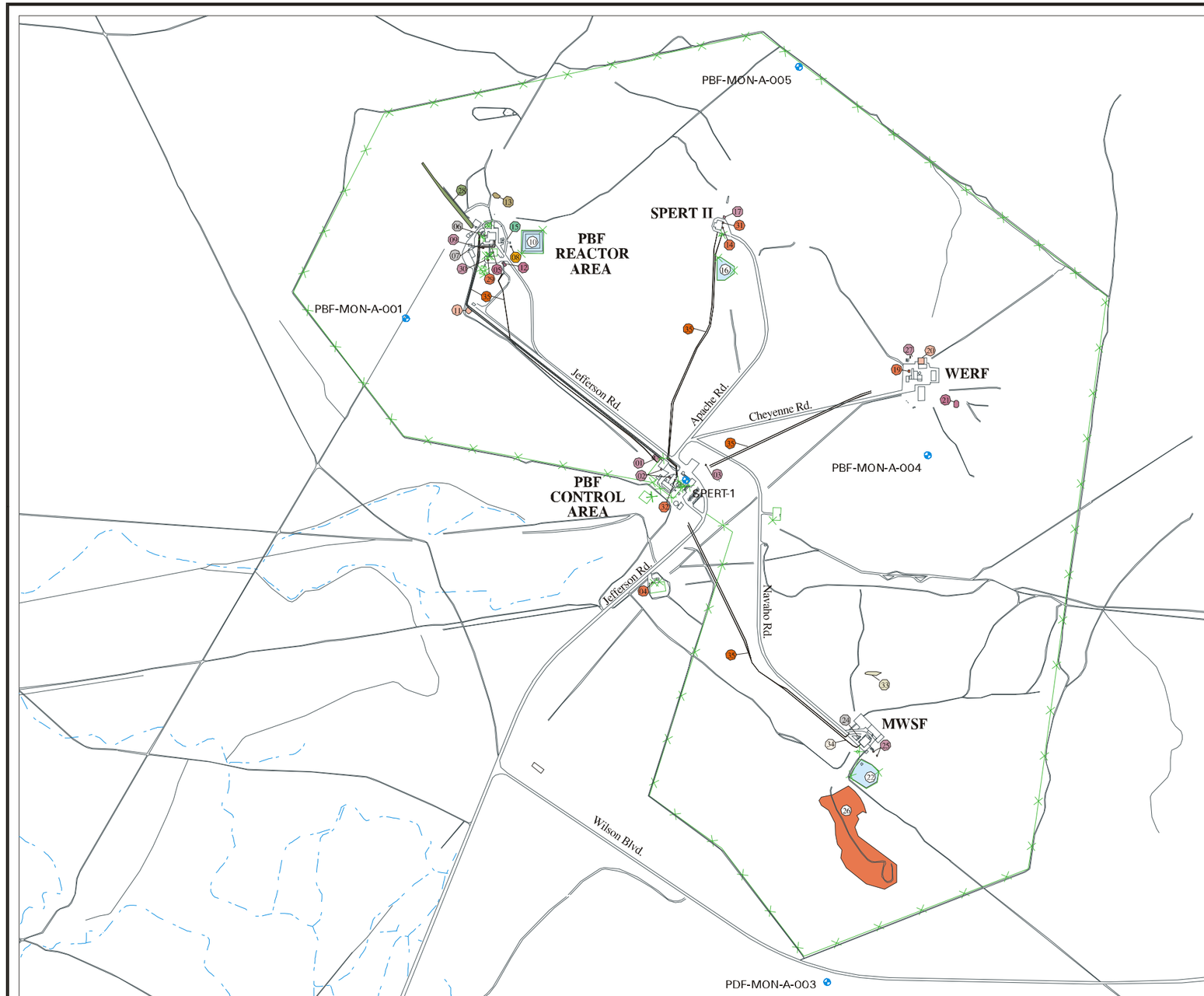
Project: WAG 5 CERCLA Sites
Developed for: Rich Wells
GIS Analyst: Dan Mahnami
Date Drawn: April 30, 2003
Disclaimer: Contact the INEEL SAL for information about the data shown on this map at 526-3529.
Path: gis_projects/ara/cercla_sites/
File Name: ara_cercla_2003-bl_v1.aml
Document Number: SAL00004685

Figure 8-1. ARA CERCLA sites.

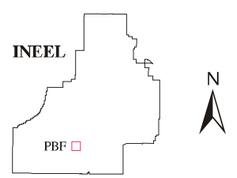


PBF
CERCLA Sites

LEGEND

- Roads and Buildings
- Fences
- Ditches
- Acids
- Acids and Bases
- Acids, Bases, and Inorganics
- Rad
- Fuel Oil and Rad.
- Metals and Rad
- Inorganics
- Inorganics, Organics, and Rad
- No Known Hazardous Materials
- PCBs
- Debris
- Construction Debris
- Construction, Inorganics
- No Action
- Wells

OPERABLE UNIT	SITE CODE	STATUS	DESCRIPTION
05- 00	PBF- 01	No Action	PBF Control Area Septic Tank (PBF- 724), Seepage Pit (PBF- 735)
05- 00	PBF- 02	No Action	PBF Control Area Septic Tanks (PBF- 738,739), Seepage Pit (PBF- 736)
05- 00	PBF- 03	No Action	PBF Control Area Septic Tank for PBF- 632 and Seepage Pits (PBF- 745,748)
05- 04	PBF- 04	Track 1	PBF Control Area Oil Tank at PBF- 608 (substation) outside PBF fence
05- 08	PBF- 05	Track 2	PBF Reactor Area Warm Waste Injection Well (PBF- 301)
05- 03	PBF- 06	Track 1	PBF Reactor Area Blowdown Pit for Reactor Boiler by PBF- 621
05- 03	PBF- 07	Track 1	PBF Reactor Area Oil Drum Storage (PER- T13)
05- 13	PBF- 08	Interim Action	PBF Reactor Area Corrosive Waste Disposal Sump Brine Tank (PBF- 731)
05- 00	PBF- 09	No Action	PBF Reactor Area Septic Tank and Drainfield (PBF 728)
05- 13	PBF- 10	Interim Action	PBF Reactor Area Evaporation Pond (PBF- 733)
05- 08	PBF- 11	Track 2	PBF SPERT I Seepage Pit (PBF- 750)
05- 02	PBF- 12	Track 1	PBF SPERT I Leach Pond
05- 03	PBF- 13	Track 1	PBF Reactor Area Rubble Pit
05- 04	PBF- 14	Track 1	PBF SPERT II Inactive Fuel Oil Tank (front of PBF- 612)
05- 08	PBF- 15	Track 2	PBF Reactor Area Corrosive Waste Injection Well (PBF- 302)
05- 09	PBF- 16	Track 2	PBF SPERT II Leach Pond
05- 00	PBF- 17	No Action	PBF SPERT II Septic Tank and Seepage Pit (PBF 725)
05- 04	PBF- 19	Track 1	PBF SPERT III Inactive Fuel Oil Tank at PBF- 609 (west side of WERF)
05- 09	PBF- 20	Track 2	PBF SPERT III Small Leach Pond
05- 02	PBF- 21	Track 1	PBF SPERT III Large Leach Pond
05- 09	PBF- 22	Track 2	PBF SPERT IV Leach Pond (PBF- 758)
05- 03	PBF- 24	Track 1	PBF SPERT IV Blowdown Pit (adjacent to PBF- 716)
05- 00	PBF- 25	No Action	PBF SPERT IV Septic Tank and Leach Pit (PBF 727 and 757)
05- 02	PBF- 26	Track 1	PBF SPERT IV SPERT Lake (adjacent to PBF- 758)
05- 00	PBF- 27	No Action	PBF SPERT III Septic Tank (PBF- 726) and Seepage Pit
05- 03	PBF- 28	Track 1	PBF Cooling Tower Area and Drainage Ditch
05- 12	PBF- 29	Track 1- NSI	PBF Reactor Area Abandoned Fuel Oil Tank
05- 12	PBF- 30	Track 1- NSI	PBF Reactor Area Abandoned Septic System
05- 12	PBF- 31	Track 1- NSI	SPERT II Fuel Oil Tank
05- 12	PBF- 32	Track 1- NSI	PBF Control Area Fuel Oil Tank
10- 08	PBF- 33	Track 1	Abandoned Debris Trench
10- 08	PBF- 34	Track 1	Abandoned Debris Located Near the MWSF
10- 08	PBF- 35	Track 1/NSI	Abandoned Power & Control Cables between buildings at the PBF Complex (PBF Reactor Area Control Cables)



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Project: WAG 5 CERCLA Sites
Developed for: Rich Wells
GIS Analyst: Dan Mahnami
Date Drawn: May 01, 2003
Disclaimer: Contact the INEEL SAL for information about the data shown on this map at 526-3529.
Path: gis_projects/pbf/cercla_sites/
File Name: pbf_cercla_2003-bl_v1.aml
Document Number: SAL00004703

Figure 8-2. PBF CERCLA sites.

The OU 5-12 ROD (DOE-ID 2000a) evaluated 55 individual sites that were identified in the WAG 5 comprehensive remedial investigation/feasibility study (RI/FS) (Holdren et. al 1999). Of the 55 sites, the ROD provided information to support remedial actions for six sites at ARA (ARA-01, -02, -12, -16, -23, and -25) and one at PBF (PBF-16) where contamination presented an unacceptable risk to human health and the environment. The OU 5-12 ROD also reviewed the no action determination for the ARA-I chemical evaporation pond (ARA-01) and stated that remedial action was required. The OU 5-12 ROD also established that groundwater monitoring was to be conducted at WAG 5 until results of a five-year review warranted discontinuation of the monitoring. This monitoring resulted from a concern about elevated lead concentrations that had been detected in selected wells at the site.

As part of the OU 5-12 remedial action, a new site designated as PBF-37 was identified as requiring remediation. Site PBF-37 consists of contaminated soil beneath the floor slab and foundation of the Power Excursion Reactor (PER)-751 radioactive waste storage tank pump house. A New Site Identification Form was completed for this site in September 2004. It was anticipated that this contaminated soil site could be remediated in a manner similar to all other Phase II OU 5-12 contaminated soil (i.e., soil removal to either basalt or designated remedial action guidelines). As such, the agencies agreed to include Site PBF-37 under the OU 5-12 remedial action for contaminated soils. The site was remediated in the fall of 2004, with all residual sampling results returned by the winter of 2004/2005.

Institutional controls were also required for six of the seven remedial action sites—the exception being Site PBF-16. No additional remediation activities were conducted for the remaining 48 sites in WAG 5, but the ROD did require institutional controls for nine of the 48 sites. A no-action decision was made for the remaining 39 sites, because they presented no unacceptable risks. Also included in the ROD are the institutional control requirements associated with both the residual PBF evaporation pond (Site PBF-10), which was remediated as part of the OU 5-13 interim ROD, and the residual SL-1 burial ground (Site ARA-06), which was remediated in accordance with the OU 5-05 ROD (INEL 1996).

In addition, four previously identified inactive waste systems were closed during the OU 5-12 remediation activities as part of "best management" practices. These four sites were Site ARA-07 (the seepage pit east of ARA-II [ARA-720A]), Site ARA-08 (the seepage pit west of ARA-II [ARA-720B]), Site ARA-13 (the area around the ARA-III sanitary sewer distribution box and septic tank [ARA-740]), and Site ARA-21 (the ARA-IV test area septic tank and Leach Pit No. 2). Details of remedial actions for each of the remediation sites are discussed in the following subsections.

Table 8-4 provides a chronology of the major remedial action events associated with WAG 5.

Table 8-4. Chronology of WAG 5 events.

Event	Date
SPERT-I reactor operations began.	1955
The ARA-I, -II, and -IV facilities were constructed.	1957
SPERT-II reactor operations began.	1958
The ARA-III facility was constructed to house the Army Gas-Cooled Reactor Experiment.	1959
SPERT-II reactor operations began.	1960
The SL-1 reactor accident occurred.	January 1961

Table 8-4. (continued).

Event	Date
The Army Gas-Cooled Reactor Experiment at ARA-III was deactivated.	1961
SPERT-IV reactor operations began.	1961
The ARA-III facility was modified to support the Mobile Low-Power Reactor tests at ARA-IV.	1963
SPERT-I reactor operations ceased.	1964
SPERT-II reactor operations ceased, and the facility was converted for research purposes.	1964
The Army Reactor Program was phased out.	1965
Nuclear Effects Reactor operations began at ARA-III.	1967
SPERT-III reactor operations ceased.	1968
ARA-III was modified to support other Idaho National Laboratory programs.	1969
Nuclear Effects Reactor operations ceased at ARA-III.	1970
SPERT-IV reactor operations ceased.	1970
PBF reactor construction was completed and operations began.	1972
The ARA-IV facility was shut down (some welding qualification work continued at the facility).	1975
The SPERT-IV reactor building decontamination and decommissioning (D&D) were completed.	1979
SPERT-III reactor building D&D was completed.	1980
Waste Experimental Reduction Facility operations began at the former SPERT-III reactor location.	1982
The ARA-IV facility D&D was completed (explosives testing continued at the facility).	1985
The SPERT-I reactor was demolished.	1985
The PBF reactor was placed in standby mode.	1985
The SPERT-IV facility was modified, becoming the Mixed Waste Storage Facility.	1985
The ARA-II facility was shut down.	1986
The ARA-I facility was shut down.	1988
The ARA-III facility was shut down.	1989
The PBF ROD was issued for the corrosive waste sump and evaporation pond (OU 5-13)—an interim action decision.	September 1992
The ROD was issued for the ARA-I chemical evaporation pond (OU 5-10)—a no-action decision.	December 1992
The remedial design/remedial action work plan (INEL 1993) was completed for the PBF-08 corrosive waste sump and PBF-10 evaporation pond (OU 5-13).	November 1993
Mobilization for the OU 5-13 remedial action occurred.	November 1993

Table 8-4. (continued).

Event	Date
The first explanation of significant difference (INEL 1994a) was issued for the OU 5-13 interim action.	May 1994
The second explanation of significant difference (INEL 1994b) was issued for the OU 5-13 interim action.	December 1994
Final demobilization from the OU 5-13 remedial action occurred.	January 1995
The remedial action report was issued for the PBF-08 corrosive waste sump and PBF-10 evaporation pond interim action (OU 5-13) (Parsons 1995).	March 1995
The RI/FS report was issued for SL-1 (OU 5-05) and the BORAX-I (OU 6-01) burial grounds (INEL 1995).	March 1995
The ROD for SL-1 burial ground (OU 5-05), the BORAX-I burial ground (OU 6-01), and 10 no-action sites within WAG 5 (OUs 5-01, 5-03, 5-04, and 5-11) was issued (INEL 1996).	January 1996
Mobilization for the OU 5-05 remedial action occurred.	July 1996
Final demobilization from the OU 5-05 remedial action occurred.	April 1997
The remedial action report for the SL-1 burial ground (OU 5-05) and BORAX-I (OU 6-01) burial ground remedial actions was completed (INEL 1997).	October 1997
ARA-II facility D&D was completed.	1997
The WAG 5, OU 5-12 comprehensive RI/FS was issued (DOE-ID 1999).	January 1999
ARA-III facility D&D was completed.	1999
The comprehensive ROD for PBF and ARA (OU 5-12) was completed (DOE-ID 2000a).	January 2000
Mobilization for the OU 5-12 remedial action, Phase I, occurred.	June 2000
Incinerator operations at the Waste Experimental Reduction Facility were shut down.	September 2000
ARA-I facility D&D was completed	2000
Revision 1 of the remedial design/remedial action work plan for Phase I of the WAG 5 comprehensive remedial action (OU 5-12) was completed (DOE-ID 2001).	June 2001
The U.S. Environmental Protection Agency completed the initial five-year remedial action review of the SL-1 and BORAX-I burial grounds (OU 5-05 and OU 6-01).	August 2001
Final demobilization from the OU 5-12 Remedial Action, Phase I, occurred.	November 2001
The remedial action report for Phase I of the WAG 5 comprehensive remedial action (OU 5-12) was issued (DOE-ID 2002).	January 2002
The remedial design/remedial action work plan for Phase II of the WAG 5 comprehensive remedial action (OU 5-12) was issued (DOE-ID 2003).	April 2003
Mobilization for the OU 5-12 remedial action, Phase II, occurred.	October 2003
The Waste Experimental Reduction Facility was closed.	2003
The mission of the Waste Experimental Reduction Facility was converted to the Large-scale Development Facility.	2004

Table 8-4. (continued).

Event	Date
The Mixed Waste Storage Facility was closed, and its mission was converted to the Contraband Detection Facility.	2004
The mission of the Waste Engineering Development Facility was converted to the Special Programs Facility.	2004
Remedial action activities and post-remediation sampling activities were completed for Phase II of the WAG 5 comprehensive remedial action (OU 5-12).	September 2004

8.1 Remedial Actions

As previously stated, four RODs have been prepared for contaminated sites within WAG 5. Based on these RODs, remedial actions have been identified for 10 individual sites, and no further actions have been identified for nine additional sites. Details of the WAG 5 remedial actions are described in the following subsections.

8.1.1 Remedy Selection

Remedies were selected for the WAG 5 sites identified as posing unacceptable risk through the CERCLA remedy selection process described in the RODs (INEL 1992a; INEL 1996; DOE-ID 2000a). The following subsections briefly describe the selected WAG 5 remedial actions.

8.1.1.1 Corrosive Waste Sump (Site PBF-08) and Evaporation Pond (Site PBF-10). The selected remedial actions at the PBF corrosive waste sump and evaporation pond consisted of removing high contaminant concentrations in the evaporation pond, stabilizing contaminated material from the pond by grouting, disposing of waste, removing sludge and sediment in the corrosive waste sump, treating materials and sediment removed from the sump by grouting if feasible, and disposing of materials.

8.1.1.2 Sanitary Waste System (Site ARA-02). The selected remedy for the sanitary waste system was removal, ex situ thermal treatment, and disposal. The activities required to implement the selected remediation alternative for this site included the following:

- Excavation and removal of the sludge and all components of the septic system
- Shipping of structural components of the system to an acceptable facility for disposal
- Thermal treatment of the sludge at an approved facility, with appropriate disposal of the treated residual
- Additional sampling of the soil to be excavated, the sludge in the seepage pit, and the septic tanks, piping, and pumice blocks
- Dust control and environmental monitoring during active remediation.

8.1.1.3 ARA-II SL-1 Burial Ground (Site ARA-06). The selected remedial action for the SL-1 burial ground included containment by capping with an engineered barrier of native materials, contouring and grading of the surrounding terrain, periodic aboveground radiological surveys, periodic inspection and maintenance, and implementation and maintenance of institutional controls. The major components of the selected remedy included the following:

- Containment by capping with an engineered barrier constructed primarily of native materials
- Contouring and grading of surrounding terrain to direct surface water runoff away from the cap
- Periodic aboveground radiological surveys after completion of the cap to assess the effectiveness of the remedial action
- Periodic inspection and maintenance after completion of the cap to ensure cap integrity and surface drainage away from the barrier
- Access restrictions consisting of fencing, posted signs, and permanent markers
- Restrictions limiting land use to industrial applications for at least 100 years following completion of the cap
- Review of the remedy no less than every five years until determined by the agencies to be unnecessary.

8.1.1.4 Radionuclide Tank (Site ARA-16). Selected remedial actions at the radionuclide tank included removal and disposal of tank contents; removal, decontamination, and disposal of the tank and pipes; removal and disposal of the concrete and gravel around the tank; removal and disposal of contaminated soil; backfilling of excavated areas; and maintenance of existing institutional controls. Specifically, the remediation alternative consisted of the following:

- Removal of waste from the tank, transferring the waste to a high-integrity container (HIC) for storage, and dewatering the waste to the extent practicable (the separated liquid phase was stabilized and sent to the Idaho CERCLA Disposal Facility [ICDF] for disposal; the sludge will be treated concurrently with the V-tanks waste, with residuals disposed of at the ICDF)
- Excavation of the tank and vault, with concrete encapsulation of the tank for disposal at the ICDF and disposal of the vault at the Radioactive Waste Management Complex (RWMC)
- Excavation of soils with Cs-137 concentrations exceeding the remediation goal and disposal of these soils at the RWMC
- Excavation and concrete encapsulation of associated piping for disposal at the ICDF
- Appropriate sampling of the subject waste streams to demonstrate that the waste met the acceptance criteria for treatment or disposal
- Dust control and environmental monitoring during active remediation
- Restoration of the site after remediation.

8.1.1.5 Contaminated Soil Sites (Sites ARA-01, ARA-12, ARA-23, ARA-25, PBF-16, and PBF-37). The following activities were chosen to remediate the six contaminated soil sites:

- Removal of soil using conventional earth-moving equipment (e.g., scrapers and backhoes)
- Real-time analyses before and during excavation to delineate the extent of contamination for removal (a combination of real-time analyses, field screening methods, and soil sampling and laboratory analyses was used to verify that the remediation goals had been satisfied)
- Backfilling with uncontaminated soil or sloping of areas excavated to depths greater than 1 ft to promote drainage (all excavations were contoured to match the surrounding terrain and were revegetated)
- Characterization of contaminated soil and permanent disposal at the ICDF

- Maintenance of institutional controls consisting of signs, access controls, and land-use restrictions (post-remediation institutional control requirements will be maintained until discontinued based on the results of this or subsequent five-year reviews and concurrence of the agencies)

- Five-year reviews of remediated sites that have institutional controls.

Originally, the SPERT-II leach pond (Site PBF-16) was thought to be contaminated with unacceptable levels of mercury, based on the results of a single sample. Subsequent sampling of the soil at the pond demonstrated that the mercury concentrations were below the remedial action goal of 0.5 mg/kg. Therefore, the proposed remediation of PBF-16 was modified to no action.

8.1.1.6 Institutional Control Sites. As a result of the PBF and ARA ROD (DOE-ID 2000a) and the OU 5-12 remedial actions, a total of 13 sites have been identified as requiring institutional controls within WAG 5. Figure 8-3 shows the locations of the ARA institutional control sites, and Figure 8-4 shows the locations of institutional control sites at PBF. Brief descriptions of the institutional controls for each of these 13 sites are provided below.

PBF Reactor Area Evaporation Pond (PBF-733) (Site PBF-10)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF SPERT-I Leach Pond (Site PBF-12)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF Reactor 4 Area Rubble Pit (Site PBF-13)—Control land use to prohibit potential exposure to friable asbestos. Augment the existing institutional controls with signs and maintenance of the existing cover. Periodic inspections will also be defined in the WAG 5 institutional controls plan (DOE-ID 2000b). Institutional controls will be maintained until discontinued based on the results of a five-year review. Recommendations for appropriate land-use restrictions will accompany any land transfer.

PBF SPERT-III Large Leach Pond (Site PBF-21)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF SPERT-IV Leach Pond (PBF-758) (Site PBF-22)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

PBF SPERT-IV Lake (Site PBF-26)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-I Lead Sheeting Pad near ARA-627 (Site ARA-03)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-II Stationary Low-Power Reactor No. 1 Burial Ground (Site ARA-06)—Maintain land-use controls to inhibit intrusion into the buried waste. Surface contamination will be addressed by the remediation of Site ARA-23. Institutional controls will be maintained until discontinued based on the results of a five-year review. Recommendations for appropriate land-use restrictions will accompany any land transfer.

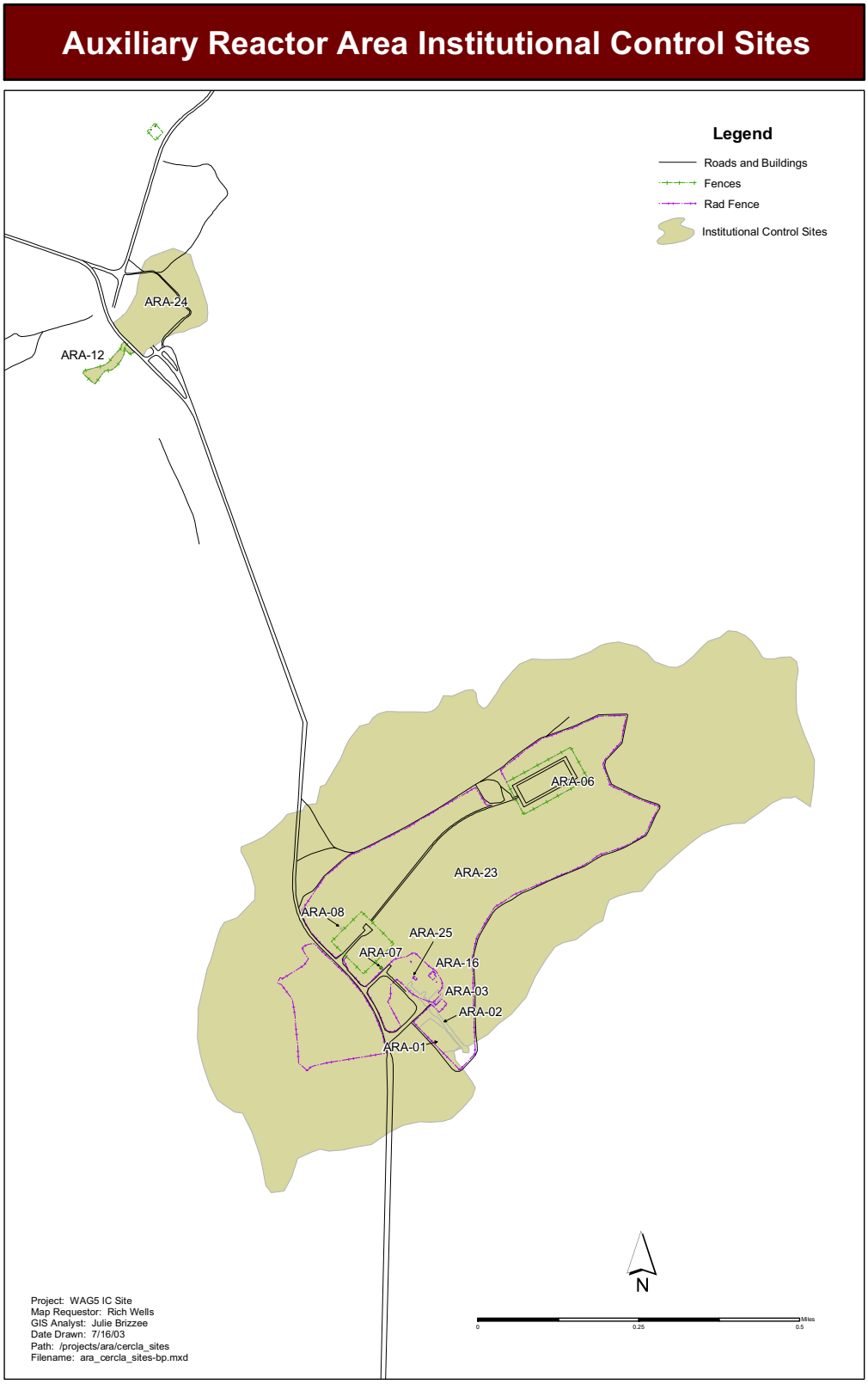

Figure 8-3. ARA institutional control sites.

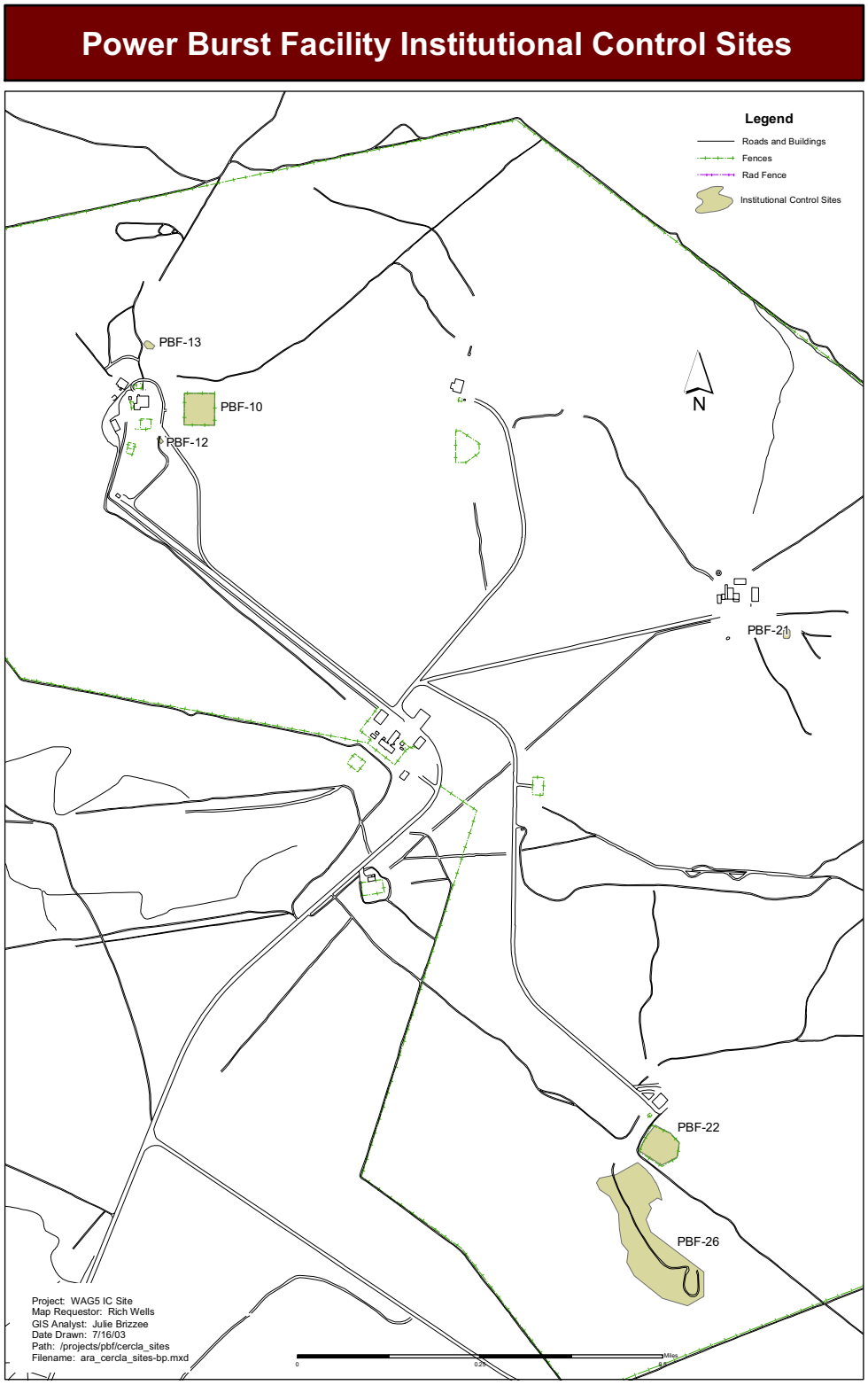

Figure 8-4. PBF institutional control sites.

ARA-II Seepage Pit to East (ARA-720A) (Site ARA-07)—Restrict the site to industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-II Seepage Pit to West (ARA-720B) (Site ARA-08)—Restrict the site to all but industrial land use until the restriction is discontinued based on the results of a five-year review.

ARA-II Radiologically Contaminated Surface Soils Around ARA-I and -II (Site ARA-23)—Restrict the site to all but industrial land use until remediation is implemented as prescribed in the ROD. Land-use controls will not be required after remediation if all contaminated soil is removed to basalt or contaminant concentrations are comparable to local background values. Otherwise, institutional controls will be maintained until discontinued based on the results of a five-year review.

ARA-III Windblown Soil (Site ARA-24)—Land use will be restricted to prohibit potential exposure to radiologically contaminated material. Institutional controls will be maintained until discontinued based on the results of a five-year review. Recommendations for appropriate land-use restrictions will accompany any land transfer.

ARA-I Soils beneath the ARA-626 Hot Cells (Site ARA-25)—Restrict the site to all but industrial land use until remediation is implemented as prescribed in the ROD. Land-use controls will not be required after remediation if all contaminated soil is removed to basalt or contaminant concentrations are comparable to local background values. Otherwise, institutional controls will be maintained until discontinued based on the results of a five-year review.

Before remedial action activities, a total of 15 institutional control sites had been identified. The initially identified sites included ARA-01, -02, -12, and -16, but did not include ARA-07 and -08. The reason for eliminating ARA-01, -02, -12, and -16 from institutional controls was that remediation of the sites reduced contamination below levels required for free release.

The institutional control sites that were added (ARA-07 and -08) came about as part of additional remedial actions aimed at closing certain sites as part of best management practices. A total of four of theses sites were identified during Phase I remediation activities. These sites included ARA-07 and -08 as well as ARA-13 and -21. After remediation of each of these sites, their residual surfaces were evaluated to ascertain which of the sites needed institutional controls. Based on the review, ARA-07 and -08 were identified as requiring institutional controls.

Table 8-5 provides a current list of the institutionally controlled sites at WAG 5, identifies the COCs and the concentration for each, the release criteria, and the expected release date.

Table 8-5. WAG 5 institutionally controlled sites.

Site	COC	Concentration	Analysis Date	Release Criteria	Release Date
ARA-03	Cs-137	5.00 pCi/g (95% Student's t upper confidence limit [UCL])	September 27, 1994	2.4 pCi/g	January 2036
ARA-06	Cs-137 Sr-90	22,900 pCi/g (maximum) 21,500 pCi/g (maximum)	July 1994	2.4 pCi/g 2,100 pCi/g	July 2394
ARA-07	Cs-137	17.6 pCi/g (maximum)	June 1991	2.4 pCi/g	June 2078
ARA-08	Cs-137	11.6 pCi/g (maximum)	June 1991	2.4 pCi/g	December 2059

Table 8-5. (continued).

Site	COC	Concentration	Analysis Date	Release Criteria	Release Date
ARA-23	Cs-137	83.8 pCi/g[a] (95% UCL)	September 2004	2.4 pCi/g	November 2158
ARA-24	Cs-137	< 5 pCi/g (maximum)	September 1997	2.4 pCi/g	August 2029
ARA-25	Cs-137 Ra-226 Arsenic Lead Copper	398 pCi/g (maximum) 26.3 pCi/g (maximum) 36.0 mg/kg (maximum) 1,266 mg/kg (maximum) 201 mg/kg (maximum)	September 2001	2.4 pCi/g 0.52 pCi/g 5.8 mg/kg 400 mg/kg 220 mg/kg	Indefinite
PBF-10	Cs-137	15.8 pCi/g (95% Student's t UCL)	August 18, 1994	2.4 pCi/g	August 2076
PBF-12	Cs-137	16.37 pCi/g (95% approximate gamma UCL)	December 1984	2.4 pCi/g	August 2068
PBF-13	Asbestos	Not applicable (NA)	NA	NA	Indefinite
PBF-21	Cs-137	18.4 pCi/g (99% Chebyshev UCL)	December 1982	2.4 pCi/g	September 2071
PBF-22	Cs-137	4.42 pCi/g (99% Chebyshev UCL)	December 1988	2.4 pCi/g	August 2015
PBF-26	Cs-137	4.67 pCi/g (95% Student's t UCL)	December 1985	2.4 pCi/g	August 2012

[a] This concentration represents the maximum 95% UCL for one of five zones defined for ARA-23. The 95% UCL concentrations for the other four zones range from 9.5 to 22.3 pCi/g.

8.1.2 Remedial Action Objectives

Remedial action objectives (RAOs) for the WAG 5 sites were developed in accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," and U.S. Environmental Protection Agency (EPA) guidance. The RAOs result from risk assessments and are specific to the COCs and exposure pathways developed in the RODs for OUs 5-05, 5-13, and 5-12.

The RAOs for the corrosive waste sump and the evaporation pond at PBF are established in the OU 5-13 ROD (INEL 1992a), and RAOs for site SL-1 burial ground were established in the OU 5-05 ROD (INEL 1996). The RAOs for the sanitary waste system, the radionuclide tank, and the contaminated soil sites are presented in the ROD for OU 5-12 (DOE-ID 2000a). Detailed RAOs for each of the sites are presented in the following subsections.

8.1.2.1 Corrosive Waste Sump (Site PBF-08) and Evaporation Pond (Site PBR-10).

Cleanup goals for the PBF waste sump and evaporation pond sediments were developed based on a site-specific, residential-use scenario for a population that begins residing at the site in 100 years. This scenario results in the calculation of a conservative cleanup level protective of current occupational and future residential populations at PBF. The cleanup goal for chromium was 800 mg/kg. This level was established using equations from the Risk Assessment Guidance for Superfund, Part A (EPA 1989) and site-specific exposure parameters for the residential use scenario. As established in the OU 5-13 ROD, the cleanup goal for Cs-137 in 1992 was 30 pCi/g and corresponded to a future excess cancer risk (100 years in the future) of 5×10^{-5}. Both cleanup levels were calculated using EPA-approved methods.

8.1.2.2 Sanitary Waste System (Site ARA-02). The RAOs for the sanitary waste system applied only to the ARA-02 seepage pit sludge, because all of the COCs at the site were contained within the sludge. As a result, the RAOs developed to protect human health included the following:

- Inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 for current and future workers and future residents.
- Inhibit dermal absorption of COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 or a hazard index of 2 or greater for current and future workers and future residents.

8.1.2.3 ARA-II SL-1 Burial Ground (Site ARA-06). Results of the remedial investigation and baseline risk assessment indicated that exposure to penetrating radiation from contaminated soils and material within the burial ground presented the most significant future risk to human health. Therefore, the primary RAOs and the focus of the remedial action alternative development were to inhibit exposure to radioactive materials. RAOs established to protect human health included the following:

- Inhibit exposure to radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).
- Inhibit ingestion of radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).
- Inhibit inhalation of suspended radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).
- Inhibit degradation of the burial grounds that could result in exposure of buried waste or migration of contaminants to the surface that would pose a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).

The RAO for protection of the environment focuses on preservation of the local ecology by inhibiting the potential for contaminant migration. The RAO established for protection of the environment is to inhibit adverse effects to resident species from exposure to contaminants at the burial ground.

As a result of these risks, a containment strategy was selected as the most appropriate remedy for the SL-1 burial ground.

8.1.2.4 Radionuclide Tank (ARA-16). Remediation objectives, based on the risks discussed in the OU 5-12 ROD (DOE-ID 2000a), were developed for the soil at the ARA-16 radionuclide tank. A risk of 1E-04 was posed to human health primarily by external exposure to ionizing radiation from Cs-137. In addition, remediation was applied to address the principal threat waste contained in the tank.

Because a release to the environment had not occurred, the contents of the radionuclide tank were not quantitatively evaluated in the remedial investigation/baseline risk assessment. Therefore, the risk assessment was limited to evaluating the soil outside of the tank. Cs-137 was the only COC identified for Site ARA-16 based on human health risks. The total estimated risk for the 100-year future residential scenario for the soil around the tank was 1E-04 (1 in 10,000) from Cs-137. The noncarcinogenic hazard quotient for residential exposure was less than 1. The total estimated risk for all pathways for the current occupational scenario was 3E-04, with a hazard index for the current occupational exposure of less than 1. The total estimated risk for all pathways for the 100-year occupational scenario was 1E-04 (1 in 10,000), with the primary contributor being Cs-137. The noncarcinogenic hazard index for the future occupational exposure was less than 1.

The human health threat posed by the radioactively contaminated soil and gravel in and around the ARA-16 tank vault is external exposure to ionizing radiation. No unacceptable ecological risk was associated with this site. The RAO developed for the soil and gravel was to inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 for current and future workers and for future residents. To meet this goal, a remediation goal of 23 pCi/g for Cs-137 was established. In addition, remediation was applied to address the principal threat waste contained in the tank.

Though no releases occurred from the ARA-16 tank and the tank was not leaking, the tank contents were identified as principal threat waste and could have posed an unacceptable risk if released to the environment. Therefore, an additional RAO was developed to prevent release of the tank contents and preclude human and ecological exposures to the ARA-16 tank contents.

8.1.2.5 Contaminated Soil Sites (Sites ARA-01, ARA-12, ARA-23, ARA-25, and PBF-37).

A human health risk of 1E-04 at the contaminated soil sites was posed primarily by external exposure to ionizing radiation. The radioactive COCs were Ag-108m, Cs-137, and Ra-226. Dermal adsorption of arsenic and ingestion of Ra-226, arsenic, and lead posed secondary human health risks. Ecological hazard quotients greater than 10 were from exposure to selenium, thallium, copper, mercury, and lead in the soil.

The following RAOs were developed for the contaminated soil sites to protect human health and the environment:

- Inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 for current and future workers and future residents.
- Inhibit dermal adsorption of COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 or a hazard index of 2 or greater for current and future workers and future residents.
- Inhibit ecological receptor exposures to contaminated soil with concentrations of contaminants greater than or equal to 10 times background values and that result in a hazard quotient greater than or equal to 10.

Remediation goals were established to meet these RAOs. Remediation goals can be satisfied by either cleaning up to the identified contaminant concentration or by removing all soil down to the basalt interface. Removing soil down to basalt will be protective, because surface exposure pathways will be eliminated. The WAG 5 comprehensive RI/FS (DOE-ID 1999) showed that groundwater exposure pathways pose a cumulative risk of less than 1E-04 and a hazard index of less than 1 for the baseline no-action alternative. Removal of contaminated soil further reduces the potential groundwater risk. Therefore, remediation to retrieve residual contamination that might have migrated into the fractured basalt would not be justified.

8.1.3 Remedy Implementation

8.1.3.1 Corrosive Waste Sump (Site PBF-08) and Evaporation Pond (Site PBF-10).

The OU 5-13 interim action was performed in two phases. The first phase consisted of excavation of the evaporation pond sediments, removal and replacement of the corrosive waste sump discharge pipe, and initial remediation activities for the sump. The second phase consisted of the final sump remediation activities. Details of the remediation are documented in the *Final Remedial Action Report: Power Burst Facility (PBF)-08 Corrosive Waste Sump and PBF-10 Evaporation Pond Interim Action, Operable Unit 5-13* (Parsons 1995).

Major components of the interim remedial action were as follows:

- Installation of engineering barriers to control dust migration
- Installation of a modular tank to receive discharges that could have occurred during the interim action due to an emergency situation and to be used for future discharges in lieu of the evaporation pond
- Excavation and placement (in low-level waste containers) of residual sludge and sediments from the corrosive waste sump to eliminate future contamination to the tank during discharge events, which was followed by decontamination of the sump interior
- Removal and placement (in low-level waste containers) of the discharge pipe from the corrosive waste sump to the evaporation pond
- Installation of new discharge piping from the corrosive waste sump to the modular tank
- Excavation and placement (in low-level waste containers) of 170 yd^3 of sediments from the evaporation pond using shovels and a skid-steer front-end loader to remove from the evaporation pond contaminated sediments with chromium concentrations greater than 800 mg/kg and/or Cs-137 concentrations greater than 30 pCi/g
- Verification sampling beneath the existing liner to ensure that remaining concentrations of chromium and Cs-137 were below the cleanup levels
- Transport of filled low-level waste containers to the RWMC for disposal.

The OU 5-13 interim remedial action was initiated in 1993 and completed in 1994. During interim actions, changes made to the proposed remedial action were sufficient to require two explanations of significant differences (ESDs). The first ESD (INEL 1994a), issued in May 1994, increased the estimated amount of evaporation pond sediments requiring excavation from 100 yd^3 to 170 yd^3 while containing the sludge and sediments instead of stabilizing them, because the ungrouted sediments were found to meet the waste acceptance criteria for disposal at the RWMC. The second ESD (INEL 1994b), issued in December 1994, found that the wastes in the corrosive waste sump were characteristically toxic for chromium and would have to be stabilized in a more leach-resistant manner than previously estimated, increasing costs by more than 50%.

Initial remediation activities involved flushing the interior walls of the sump. First, a high-pressure sprayer was used to flush the walls of the sump and increase liquid volume, and then sump pumps were used to pump the residual liquid and sprayer rinsate to the evaporation pond. The initial flush pumped all of the sump water to the evaporation pond without suspending the sludge and sediment at the bottom of the sump. After flushing, the sump discharge line was removed, cut into 1-ft sections, and disposed of at the Central Facilities Area (CFA) bulky waste landfill (since no radioactive contamination was detected). New underground piping was then installed from the large modular tank to the sump. The modular tank used was 63 ft in diameter, and 5.5 ft high, with a capacity of 124,000 gal. The cylindrical tank was fabricated with metal sidewalls, two interior Hypalon liners, and a drainage monitoring system between the liners.

The subsequent step in the OU 5-13 remediation was to excavate the evaporation pond sediments. The evaporation pond was divided into 49 grids, each having approximate dimensions of 20 × 20 ft. Each grid was surveyed to ascertain those that needed to be excavated. Based on that survey, 21 of the 49 grids were marked for excavation. Laborers then used square-pointed shovels (initially) and a skid loader to excavate the contaminated soils from each of the 21 grids. Water sprays were used to prevent fugitive dust generation during excavation.

After evaporation pond excavation, remediation activities returned to the corrosive sump pump. The residual sludge and sediment from the bottom of the sump was removed using slurry pumps and a mobile filter press. The diatomaceous earth served as the pre-coat material for the filter plates. Squeegees were used to force the sludge particles to the slurry pump because of an inability to suspend the sludge using air sparging equipment. The conveyed sludge was then pumped to the filter press, where the sludge was retained on the filter plates while the effluent was circulated back into the sump. After filling the filter plates with sludge, the sludge was dewatered, and the dry filter cake was scraped off and placed in interim storage at PBF. A high-pressure wash was used to remove surface contamination from the interior of the sump. The rinse water was processed through the filter press and then discharged in the modular evaporation tank.

After sludge removal, a toxicity characteristic leaching procedure analysis of the dewatered sludge found that it was characteristically toxic for trivalent chromium. The sludge was removed from storage at PBF, repackaged, and transported to the Mixed Waste Storage Facility, where the sludge was managed in accordance with the requirements of that facility's Resource Conservation and Recovery Act (RCRA) Part A permit.

8.1.3.2 Contaminated Soil beneath PER-751 Pump House Floor Slab and Foundation (Site PBF-37). Site preparation for PBF-37 included establishing work control areas and controlled access points. Before sampling the soil, workers removed the soil cover that had been put in place after demolition and removal of the PER-751 tank and pump house. A front-end loader was used to scrape the soil cover into a pile. This facilitated sampling of the contaminated area. Before actual soil removal, the underlying tarps were removed. A backhoe was staged at the task site for removal of the contaminated soil. Soft-sided sacks were obtained to use as containers for the soil that was removed.

The extent of the site remediation was based on the original radiological survey of the posted soil contamination area. The controlled area measured roughly 20 ft wide and 40 ft long. A more defined area for purposes of soil removal was based on an in situ gamma survey that was conducted after soil samples were collected and by using hand-held survey instruments. In accordance with this survey, an 8- × 8-ft area found to have the highest level of contamination (based on the in situ gamma survey) was delineated in the southwestern quadrant of the site. To ensure optimum contamination removal, this area was excavated to a depth of 2 ft using a backhoe. Soil in the remaining contaminated soil area was excavated to a depth of 1 ft. A large concrete pier that supported the south tank saddle was encountered during excavation.

Excavated soil was placed in 12 soft-sided bags. These bags were loaded onto trailers and transferred to a registered CERCLA storage area located at the PBF Control Area. The storage area will be inspected weekly by a Waste Generator Services facility representative.

8.1.3.3 ARA-I Chemical Evaporation Pond (Site ARA-01). The chemical evaporation pond is a shallow, unlined surface impoundment roughly 100 × 300 ft that was used to dispose of laboratory wastewater from the ARA-I Shop and Maintenance Building (ARA-627). Located southeast of ARA-I, the pond was constructed in 1970 by excavating soil to create a shallow topographic depression. Basalt outcrops are present within and immediately adjacent to the pond. The subsurface immediately beneath the pond consists of fracture and rubble zones. No interbed was found within the first 118 ft of the surface.

Contaminated soil was excavated from the pond in accordance with the requirements delineated in the *Record of Decision Power Burst Facility and Auxiliary Reactor Area, Operable Unit 5-12* (DOE-ID 2000a). This was followed by in situ field screening measurements and confirmation sample analysis of the residual soil surface.

8.1.3.4 ARA-I Sanitary Waste System (Site ARA-02). The septic system serviced the ARA-I facility from 1960 until 1988. Site ARA-02 was defined as the entire septic system, including the three tanks (one septic tank, one settling tank, and one chlorine contact tank), a seepage pit, three manholes, and all associated piping leading from source buildings (both 4- and 8-in. diameter) as well as any contiguous soil contaminated from system materials. The septic system serviced ARA-I Buildings 626, 627, and 628 and Office Trailers 1 and 2 outside of the ARA-I facility fence. The vertical extent of the site was defined by the depth to the soil/basalt interface.

At Site ARA-02, the entire septic system was removed in accordance with the requirements of the *Record of Decision Power Burst Facility and Auxiliary Reactor Area, Operable Unit 5-12* (DOE-ID 2000a). The seepage pit sludge was removed and disposed of, thus mitigating the human health risk associated with this site.

8.1.3.5 ARA-II SL-1 Burial Ground (Site ARA-06). Remediation of the SL-1 burial ground was performed in 1996 and 1997. Details of the SL-1 burial ground remedial action are contained in the *Remedial Action Report: OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling Water Reactor Experimental-I Burial Grounds Engineered Barriers* (INEL 1997).

The SL-1 contaminated-soil area was initially excavated to a depth of 6 in. using two front-end loaders. This was followed by the excavation of 1,527 yd^3 of contaminated soil in certain designated "hot spots." The 2,407 yd^3 of excavated contaminated soil was then transported, spread, and compacted over a 530- × 40-ft soil consolidation area between Trench 1 and Pit 2 of the SL-1 burial ground. This was followed by the addition and compaction of 9.9 yd^3 of investigation-derived waste into the soil consolidation area. A 22-in.-thick biotic barrier consisting of pea gravel and cobble was then placed over the soil consolidation area, followed by a human intrusion barrier of large angular basalt boulders. This was followed by the placement of fences, gates, and four granite monuments at the SL-1 site. After construction of the cap, the area around the cap was recontoured and reseeded. Institutional controls over the SL-1 burial ground were established in the OU 5-12 ROD (DOE-ID 2000a).

8.1.3.6 Radioactive Waste Leach Pond (Site ARA-12). The radioactive waste leach pond was an unlined surface impoundment with approximate dimensions of 150 × 370 ft. The pond was constructed in a natural depression west of ARA-III to dispose of low-level liquid waste from reactor research operations. Liquid radioactive waste was stored temporarily in tanks and then transferred to the leach pond via an underground pipe. A second separate discharge line originated at an uncontaminated water storage tank. The pond also received facility runoff through a culvert. The ARA-III facility was active from about 1959 to 1965. From 1966 to 1987, activities at ARA-III were limited to component and instrumentation testing, instrumentation development and fabrication, and chemical research. Wastes associated with these activities were not disposed of in the leach pond, and the only discharges to the pond during this period were from the water storage tank and facility runoff. The facility was shut down in 1987, leaving the pond dry except during spring runoff and heavy precipitation. In 1991, the culvert was plugged in preparation for decontamination and decommissioning (D&D) operations at ARA-III. In 1993, the tanks and waste lines to the leach pond were removed. Contaminated soil from Site ARA-12 was excavated in accordance with the requirements outlined in the OU 5-12 ROD (DOE-ID 2000).

8.1.3.7 ARA-I Radionuclide Tank (Site ARA-16). The radionuclide tank was a 1,000-gal stainless-steel underground tank that rested on a 6-in. gravel bed inside an open-topped concrete vault. The tank was 12 ft long and approximately 4 ft in diameter. The tank was connected to the ARA-626 and -627 buildings within the ARA-I facility via stainless-steel piping. The tank had been partially excavated in the past for sampling; therefore, the depth of the fill material varied from the original design.

The tank had several piping connections, along with an internal pump and a manway cover. During initial remedial action activities, the pump and all external piping were removed from the tank. Connective piping to the tank was then cut and capped to isolate the tank. After the tank was isolated, approximately 317 gal of waste was removed from the tank and placed into a 400-gal HIC. The tank was rinsed, and the rinsate was also pumped to the HIC. The HIC allowed for the separation of the sludge from the liquid phase by pumping the liquid through a filtered media. The liquid phase was passed through a carbon filter (to remove trace organic contamination) and solidified in 55-gal lined steel drums using a sodium polyacrylate monopolymer (i.e., Stergo). The slurry left in the HIC consisted of approximately 4.5 gal of sludge and 75.5 gal of supernatant. The slurry was a Type B radioactive waste that was transuranic and listed for both 1,1,1-trichloroethane (F001) and toluene (F005).

The HIC that contained the concentrated waste was shielded and initially placed in storage at ARA-I awaiting eventual treatment as part of the OU 1-10 V-tank waste treatment, which was scheduled for early 2005. The HIC has subsequently been shipped to Test Area North, where the waste awaits treatment. Pumping the waste out of the tank was followed by removal and disposal of both the tank (along with all associated piping) and the concrete vault surrounding the tank. Both removal actions were performed in accordance with the requirements of the OU 5-12 ROD (DOE-ID 2000a). Excavation proceeded to the basalt layer in some locations.

8.1.3.8 Radiologically Contaminated Surface Soil and Subsurface Structures associated with ARA-I and ARA-II (Site ARA-23).

Site ARA-23 is a 240-acre windblown-contamination area that includes both residual subsurface structures from ARA-I and -II and the areas surrounding ARA-I and -II. Of the 240 acres, 42 acres exceeded risk-based concentrations and required remediation. The site also contained subsurface structures remaining after D&D activities within ARA-I and -II. The radioactive contamination in the windblown soil was primarily due to contamination released from the 1961 SL-1 accident and its subsequent cleanup. Minor amounts of contamination might have been added by other ARA operations, however. Over time, winds dispersed the contamination over an area of roughly 240 acres, but most of this windblown contamination is significantly less than risk-based remediation goals. The long axis of the roughly oval-shaped site is consistent with the generally southwest-to-northeast winds common at the INL site.

The contaminated soil was removed from Site ARA-23 in accordance with the requirements delineated in the OU 5-12 ROD (DOE-ID 2000a). Soil contaminated with Cs-137 was removed and disposed of in a manner that mitigated the human health risk associated with this site. Excavation activities in 2003 were concentrated in the soil-contamination area next to Fillmore Boulevard at ARA-I and the area between the fence outside of the ARA-II facility and the windblown area. In 2004, excavation consisted of the windblown contamination area, the contaminated soil area near the haul road, the area near the SL-1 burial ground, the turnaround area, areas on top of the SL-1 burial ground, the area north of ARA-II, the washdown area across Fillmore Boulevard, and the bermed area next to ARA-I. In general, excavation was done using 1- to 6-in. excavation cuts over the entire contaminated soil area, followed by spot excavations in the more contaminated soil areas. In addition, the fence surrounding the ARA-II facility was removed and disposed of at the ICDF in 2004.

8.1.3.9 ARA-I Soil beneath the ARA-626 Hot Cells (Site ARA-25).

Site ARA-25 comprised contaminated soil that was discovered beneath the ARA-626 hot cells during D&D activities at the ARA-I facility in 1998. The contamination was found near the hot cell floor drains. The contaminated area immediately around the drains measured approximately 8 × 12 ft. However, other isolated hot spots beneath the building were also discovered. Therefore, a cumulative size of 16 × 24 ft was estimated for the site. The ARA-I hot cells were constructed in 1959 and used until the facility was shut down in 1988. Stainless-steel piping connected the floor drains to the ARA-729 radionuclide tank (Site ARA-16). The pipes were included in the remediation of Site ARA-16 and were not a component of Site ARA-25.

The contaminated soils at Site ARA-25 were removed in accordance with the requirements of the OU 5-12 ROD (DOE-ID 2000a). The hot cell foundation was initially removed to allow for excavation of the underlying and immediately surrounding soil. The contaminated soil area was then removed to the basalt sublayer.

8.1.3.10 Inactive Waste System Sites. As previously stated, four inactive waste system sites (ARA-07, -08, -13, and -21) were removed or abandoned in accordance with established regulatory standards. The following subsections discuss the actions taken at each of those four sites.

ARA-II Seepage Pit to the East (ARA-720A) (Site ARA-07)—Site ARA-07 was one of the no-action sites closed as part of Phase I cleanup activities during remediation of OU 5-12. The pit was constructed of 8- × 8- × 16-in. pumice blocks laid on their sides in the shape of a circle. The seepage pit had a diameter of 13 ft and a depth of 10 ft. The top two courses of pumice blocks were set in mortar. As-built drawing No. 102832 shows the first course of blocks set on bedrock and leveled with concrete. The pit had a gravel base and contained approximately 6 to 12 in. of sludge. The top of the pit extended above the ground and was covered by a wooden roof with lifting rings and a 2- × 2-ft square access port. A 4-ft-high chain-link fence surrounded the entire structure.

The seepage pit was just outside of the ARA-II facility fence and was the terminus of two septic tanks serving the Administration Building (Building 613) and the Technical Support Building (Building 602). The seepage pit was also thought to be the terminating point for an underground waste detention tank (ARA-719), which was removed during D&D activities (INEEL 1999). The system was used from approximately 1959 to 1986. To close the pit, the roof structure and top two courses of cement blocks were removed and disposed of. The seepage pit was then filled with earthen material and abandoned.

ARA-II Seepage Pit to the West (ARA-720B) (Site ARA-08)—Site ARA-08 was another no-action site that was closed as part of Phase I cleanup activities during remediation of OU 5-12. The seepage pit was inactive and had a diameter of 13 ft and a depth of 10 ft. The pit was constructed using the same pumice blocks and layout as was used at Site ARA-07. The pit contained approximately 18 to 24 in. of sludge. Three separate concrete slabs measuring approximately 3 × 10 ft capped the pit. The concrete slabs were covered by approximately 3 ft of soil.

The seepage pit was just outside the ARA-II facility fence and received waste from the Administrative and Technical Support Building (Building 606). The system was used from approximately 1959 to 1986. To close the site, the concrete slab covering the pit was removed and disposed of. The pit was then filled with earthen material and abandoned.

ARA-III Sanitary Sewer Leach Field (ARA-740) (Site ARA-13)—Site ARA-13 was the third no-action site that was closed as part of Phase I cleanup activities during remediation of OU 5-12. Site ARA-13 consisted of a manhole, a septic tank system, a distribution box, and a leach field. Sanitary waste was disposed of in the system from 1969 to 1980. In addition to sanitary waste, small quantities of laboratory waste were diverted to this system between 1980 and 1983.

As part of best management practices, an estimated 2,300 gal of liquid was pumped out of the septic tank system and disposed of in the CFA sanitary sewer system. The septic tank and distribution box were then excavated to allow access to the sludge in the bottoms of the components. Upon excavation, the septic tank system was found to be three separate tanks in series. The top half of each tank was removed, and dry cement and Aquaset were mixed into the residual sludge in each tank to remove free liquids. The sludge from the septic tanks was then removed, placed into soft-sided containers, and disposed of at the RWMC. Sludge from the distribution box was removed, mixed with dry cement (to solidify free liquids),

and disposed of at Envirocare. The tops of each septic tank were surveyed, found to be free of radioactive contamination, and shipped to the CFA landfill for disposal. The ARA-13 system components remaining in the ground were then decontaminated, visually inspected, and surveyed for radiological contamination. No radiological contamination was detected. Holes were then made in the bottom of each component, and each component and the excavation were filled with earthen material before being disposed of.

ARA-IV Septic Tank and Seepage Pit #2 (Site ARA-21)—Site ARA-21 was the fourth no-action site that was closed as part of Phase I cleanup activities during remediation of OU 5-12. Site ARA-21 consisted of a 1,000-gal underground septic tank, an estimated 250- to 500-gal chlorine contact tank, and a seepage pit that received sanitary waste from the ARA-IV Test Area Building (ARA-616). The system was used from approximately 1957 to 1970. During D&D operations in 1987, the piping was cut 10 ft from the building, and the tanks and leach pit were covered with 6 ft of soil. For purposes of best-management practices, the liquid waste was removed from the septic tanks and disposed of at the CFA sanitary sewer system.

8.2 Data Evaluation

This data evaluation section includes a summary of annual site inspections, compilation and evaluation of data collected during soil excavation activities, and compilation and examination of groundwater data collected during the five years covered by this review.

8.2.1 Site Inspections

Annual site inspections included visual inspection of the engineered rip-rap and a radiological survey around the perimeter of the ARA-II SL-1 burial ground (Site ARA-06) to determine the extent, if any of contaminant migration.

Visual site inspections showed that the riprap cover is functioning as designed and showed no signs of subsidence of animal intrusion. Additionally, the results from the annual radiological surveys indicate that the remedy is functioning as intended, and no unexplained radiological anomalies have appeared.

Site inspections at institutionally controlled sites were conducted annually at ARA-03, ARA-06, ARA-07, ARA-08, ARA-23, ARA-24, ARA-25, PBF-10, PBF-12, PBF-13, PBF-21, PBF-22, and PBF-26. Visible access restrictions, control of activities, unauthorized access, and land-use restrictions were evaluated. No deficiencies were identified.

8.2.2 Corrosive Waste Sump (Site PBF-08) and Evaporation Pond (Site PBF-10)

Samples were taken of the residual sediments and surrounding soil above and below the evaporation pond liner, and radiological surveys were performed on the floor and walls of the corrosive waste sump. The radiological survey of the sump floor and walls found only fixed levels of contamination on the sump walls, ranging from 220 to 1,000 disintegrations per minute. Residual sediment samples collected above the evaporation pond liner showed Cs-137 concentrations of 11.2 to 17.5 pCi/g and chromium concentrations of 213 to 309 mg/kg, both below the established cleanup goals of 30 pCi/g for Cs-137 and 800 mg/kg for chromium. Soil samples collected below the evaporation pond liner also indicated chromium concentrations of 14.4 to 23 mg/kg (within background) with minor Cs-137 contamination. Based on these results, it was concluded that the pond liner was not breached during its operational lifetime and that all contaminants had been contained within the evaporation pond. The results also verified that the interim action could be considered complete.

Site restoration activities included backfilling and recontouring the area, followed by reseeding of the area. Interim action activities were completed in 1994. Because of its interim nature, a final ROD on the residual OU 5-13 site was not made until after the WAG 5 comprehensive ROD (OU 5-12) had been issued. Due to the lack of smearable contamination in the corrosive waste sump, however, it was anticipated that no further remedial actions or institutional controls would be required. In contrast, the Cs-137 concentration in the residual evaporation pond sediments was below cleanup goals, but the concentration was not below the free-release levels that have been set for Cs-137. Therefore, it was anticipated that institutional controls would still be required on the evaporation pond until the Cs-137 has decayed to its free-release level. Both of these expectations were confirmed when the final OU 5-12 ROD was issued (DOE-ID 2000).

8.2.3 Contaminated Soil beneath PER-751 Pump House Floor Slab and Foundation (Site PBF-37)

Characterization sampling for metals and radionuclides before remediation at Site PBF-37 demonstrated that the only COC was Cs-137. After excavation of the contaminated soils at the site, in situ surveys of the excavation were performed, and confirmation samples were collected for laboratory analysis. The three in situ survey results ranged from 1.3 pCi/g to a maximum of 2.8 pCi/g. The analytical laboratory results for the two confirmation samples were 1.42 and 2.29 pCi/g. Based on the analytical results, it is being recommended in the forthcoming remedial action report that institutional controls will not be required for the site.

8.2.4 ARA-I Chemical Evaporation Pond (Site ARA-01)

Screening sample results for arsenic at Site ARA-01 provided in situ measurements with a range of 4.8 to 9.5 mg/kg, while the in situ measurements for selenium were 0.4 to 2.0 mg/kg, and the in situ measurements for thallium were 1.3 to 2.4 mg/kg. The 95% upper confidence limit (UCL) for arsenic from the confirmation sample analytical results (calculated assuming a normal distribution, per EPA guidelines) was 7.3 mg/kg, below the remedial action goal of 10 mg/kg. For selenium, all but one of the confirmation sample results was below the method detection limit, with the single detectable concentration being 0.2 mg/kg as compared to the remedial action goal of 2.2 mg/kg. Assuming a non-parametric Chebyshev distribution (per EPA guidelines), the 95% UCL for selenium was calculated to be 0.11 mg/kg, below the remedial action level of 2.2 mg/kg. Based on a gamma distribution (again, per EPA guidelines), the 95% UCL for thallium from confirmation samples was 1.5 mg/kg, also below the remedial action goal of 4.3 mg/kg. By comparing the 95% UCL post-remediation concentrations to remediation goals, the remediation of Site ARA-01 was determined to be successful.

In accordance with the OU 5-12 ROD (DOE-ID 2000a), institutional controls were not required at ARA-01 after remediation, given that the COCs were inorganic (not radionuclides) and their post-remediation concentrations were below remedial action goals and therefore also below free-release levels.

8.2.5 ARA-I Sanitary Waste System (Site ARA-02)

In situ measurements of the soil immediately underlying the seepage pit location demonstrated that the Cs-137 concentration remaining in the soil was 0.36 ± 0.13 pCi/g. This concentration is below the remediation goal of 8.5 pCi/g for Cs-137, which was established assuming that institutional controls would be in place for 100 years before the site could be turned over for residential use and the Cs-137 had decayed. It appears that the calculated 95% UCL for the residual Cs-137 contamination at Site ARA-02 was also below the established free-release concentration of 0.86 pCi/g. The concentrations of the remaining contaminants were derived, as provided in Table 8-6, using Cs-137 as a marker and assuming

the concentrations of the other COCs present at the same ratio as the maximum concentrations provided in Table 21 of the OU 5-12 ROD (DOE-ID 2000).

Table 8-6. Evaluation of Site ARA-02 remediation activities.

COC	Maximum Concentrations before Remediation	Remediation Goal	Free-release Concentration	Post-remediation Concentration
Cs-137	178 pCi/g	8.5 pCi/g	0.86 pCi/g	0.36 pCi/g
Ra-226	89.6 pCi/g	1.2 or 2.1 pCi/g[a]	1.15 or 2.0 pCi/g[a]	0.18 pCi/g
U-235	120 pCi/g	6.2 pCi/g	6.2 pCi/g	0.24 pCi/g
U-238	190 pCi/g	10.6 pCi/g	10.6 pCi/g	0.38 pCi/g
Aroclor-1242	23.5 mg/kg	1 mg/kg	1 mg/kg	0.05 mg/kg
Lead	1,290 mg/kg	400 mg/kg	400 mg/kg	2.61 mg/kg

a. A goal of 2.1 pCi/g was used for comparison of sample results that might have included interference from U-235; otherwise, a goal of 1.2 pCi/g was used. Since U-235 was present at this site, the use of the 2.1-pCi/g remediation goal was appropriate even though the post-remediation concentration is well below either of the two Ra-226 remediation goal concentrations.

Based on comparison of the post-remediation concentrations to the remediation goals, the remediation of Site ARA-02 is successful. The residual concentrations left at Site ARA-02 are also below the free-release concentrations for all COCs. As a result, institutional controls will not be required at Site ARA-02. Although areas of surface soil contamination still exist where the concentrations of Cs-137 are elevated, this contamination is attributed to Site ARA-23 and was addressed as part of the Site ARA-23 remediation under Phase II remedial activities.

8.2.6 ARA-II Stationary Low-Power Reactor No. 1 Burial Ground (Site ARA-06)

Post-excavation sampling of the contaminated soil area at Site ARA-06 confirmed that residual soil concentrations were equal to or less than the remedial action level of 16.7 pCi/g for Cs-137.

8.2.7 Radioactive Waste Leach Pond (Site ARA-12)

After excavation, in situ measurements and confirmation samples were taken of the residual soil at Site ARA-12. The 95% UCL calculation for in situ gamma measurements of Cs-137 (based on its perceived gamma distribution at the site, per EPA guidelines) was 0.43 pCi/g. This was below the Cs-137 cleanup goal of 0.75 pCi/g, implying that the remedial action was complete. The conclusion was confirmed by the more accurate confirmation sampling results, which showed a calculated 95% UCL for Cs-137 (again, based on a gamma distribution, per EPA guidelines) of only 0.38 pCi/g. Both 95% UCLs are not only below the cleanup goal (0.75 pCi/g) but also below the free-release concentration limit (0.64 pCi/g) for Ag-108m. Likewise, calculated 95% UCLs for the residual copper (based on a gamma distribution), mercury (based on a non-parametric Chebyshev distribution), and selenium concentrations (based on a normal distribution) at Site ARA-12 were found to be 27.5 mg/kg, 0.29 mg/kg, and 0.98 mg/kg, respectively. All of these 95% UCLs were below their respective remediation goals (220 mg/kg for copper, 0.5 mg/kg for mercury, and 2.2 mg/kg for selenium). All calculations were performed in accordance with EPA guidelines.

Based on the comparison of the post-remediation concentrations to the remediation goals, the remediation of Site ARA-12 was successful. In addition, institutional controls were not required at Site ARA-12, because the concentration of Ag-108m in the residual soil after remediation were below the

free-release concentration of 0.64 pCi/g, and the concentrations of inorganic contaminants in the remediated site were below remedial action goals.

8.2.8 ARA-I Radionuclide Tank (Site ARA-16)

In situ measurement of the basalt/soil underlying the tank and vault at Site ARA-16 demonstrated that the maximum Cs-137 concentration in the remediated site was 1.5 pCi/g, well below the remediation goal of 23 pCi/g for Cs-137. As a result, remediation of Site ARA-16 was successful. The maximum concentration of Cs-137 in the remediated site was also below the free-release concentration of 2.4 pCi/g. Given that fact, institutional controls at Site ARA-16 are no longer required. Although Cs-137 was still present in surficial soils (similar to Site ARA-02), that contamination was attributed to windblown contamination from the SL-1 accident and was addressed as part of the Phase II remedial action for Site ARA-23.

8.2.9 Radiologically Contaminated Surface Soil and Subsurface Structures associated with ARA-I and ARA-II (Site ARA-23)

Because of the size of the Site ARA-23 excavation, the post-remediation evaluation activities (via sampling) were separated into five zones. The various zones of the excavation were as follows:

- Area near the ARA-I facility
- Area near the ARA-II facility
- Equipment washdown area
- Haul road and turnaround area
- Windblown area.

A review of the contamination profiles for both in situ measurements and confirmation samples found that the contamination profiles generally followed a log-normal distribution rather than a normal distribution. The only exceptions to this were the confirmation samples in the washdown area and the in situ measurements in the haul road and turnaround area.

Residual sampling results, for the ARA-I area of Site ARA-23 after remediation showed 95% UCL Cs-137 concentrations of 8.5 pCi/g for the in situ measurements (based on a gamma distribution, per EPA guidelines) and 22.3 pCi/g for the confirmation samples (based on a non-parametric Chebyshev distribution). Both calculated values were below the remedial action goal of 23 pCi/g for Cs-137. Therefore, remediation of the ARA-I excavation site within Site ARA-23 was considered complete.

For purposes of evaluating the ARA-II portion of Site ARA-23, the data had to be split into samples collected from (1) the basalt surface where excavation was to that surface and (2) samples collected from excavated soil areas. This was because the RAOs were to either excavate to basalt or excavate enough of the soil to meet the remedial action goal of 23 pCi/g for Cs-137. In situ measurements, post-remediation for the ARA-II areas in Site ARA-23 that were not excavated to basalt showed a 95% UCL Cs-137 concentration of 8.6 pCi/g (based on a normal distribution, per EPA guidelines), which was below the remedial action goal of 23 pCi/g for Cs-137. The confirmation sample data for the ARA-II site projected a 95% UCL (based on a normal distribution, per EPA guidelines) of 11.1 pCi/g, also below the remedial action goal of 23 pCi/g for Cs-137. As a result, remedial actions for the ARA-II portion of Site ARA-23 were judged to be complete in that the residual soil surface at ARA-II met the remediation goals for Cs-137.

Residual sampling results for the equipment washdown area of Site ARA-23 after remediation showed 95% UCL concentrations of 8.4 pCi/g for Cs-137 for the in situ measurements (based on a gamma distribution, per EPA guidelines) and 12.9 pCi/g for the confirmation samples (based on a normal distribution). Both calculated values were below the remedial action level of 23 pCi/g, indicating that the remediation was complete.

In situ measurements and confirmation sample results for the haul road and turnaround area of Site ARA-23 followed a gamma distribution, per EPA guidelines. The calculated 95% UCL Cs-137 concentrations of the residual soil surfaces were 7.4 pCi/g for the in situ measurements and 24.9 pCi/g for the confirmation samples. While the in situ measurements were below the remedial goal for Cs-137 (23 pCi/g), the confirmation sample results were just above the remediation goal. The reason for this was that one of these 10 samples had a Cs-137 concentration above the remediation goal of 23 pCi/g (ARA-23H-20 was 56.3 pCi/g). The same sample location provided an in situ Cs-137 concentration of 11.7 pCi/g. The high Cs-137 concentration in this single confirmation sample was attributed to a "hot particle" that incorrectly skewed the 95% UCL calculation to a level above the remediation goal and could be screened from the confirmation sample evaluation. The new 95% UCL that was calculated for Cs-137 from the other nine confirmation samples (under a normal distribution, per EPA guidance) was only 9.5 pCi/g, below the remedial action goal of 23 pCi/g. Therefore, remediation of the haul road and turnaround area of Site ARA-23 was considered complete.

In situ measurements for the windblown area of Site ARA-23, post-remediation, had a 95% UCL Cs-137 concentration of 9.3 pCi/g based on a normal distribution. Confirmation samples of the windblown area based on a gamma distribution provided a 95% UCL of 9.6 pCi/g for Cs-137. Both 95% UCLs were below the remediation goal for Cs-137 (23 pCi/g). As a result, remediation of the windblown area of Site ARA-23 was considered complete.

A summary of the residual concentrations in the excavated soil (and basalt) areas of each portion of Site ARA-23 is shown in Table 8-7. Based on the comparison of the post-remediation concentrations to the remediation goal, the remediation of Site ARA-23 was determined to be successful. However, the presence of Cs-137 contamination in excess of the free-release concentration of 2.4 pCi/g requires that institutional controls remain in place.

Table 8-7. Site ARA-23 Cs-137 data summary by area.

Area	In Situ Measurements Cs-137 (pCi/g)	Confirmation Sampling Cs-137 (pCi/g)
ARA-I	8.5[a]	22.3[b]
ARA-II	8.6[c] (soil) / 52.1[a] (basalt)	11.1[c] (soil) / 83.8[a] (basalt)
Equipment Washdown	8.4[a]	12.9[c]
Haul Road and Turnaround	7.4[a]	9.5[c,d]
Windblown	9.3[c]	9.6[a]

a. 95% UCL, determined under a gamma distribution, per EPA guidelines.
b. 95% UCL, determined under a non-parametric Chebyshev distribution, per EPA guidelines.
c. 95% UCL, determined under a normal distribution, per EPA guidelines.
d. With single outlier sample removed.

8.2.10 ARA-I Soil beneath the ARA-626 Hot Cells (Site ARA-25)

In situ measurements of the exposed basalt layer at Site ARA-25 showed a maximum Cs-137 concentration of 398 pCi/g in the basalt—in excess of the 23 pCi/g remediation goal. The measured Cs-137 concentrations were used to calculate concentrations of the remaining COCs. The concentration of Cs-137 and those derived for the other COCs are provided in Table 8-8. Although all the remaining contaminant concentrations (except copper) exceeded their remediation goals, the OU 5-12 ROD (DOE-ID 2000) stated that remedial goals can be satisfied by either cleaning up to the identified contaminant concentration or by removing all soil down to the basalt interface. Because the contaminated soil was removed down to the basalt interface, the remediation of Site ARA-25 was successful. However, the presence of high levels of Cs-137 within the basalt required the use of institutional controls at Site ARA-25. Because the residual contamination was higher than remediation goals, institutional controls will be needed at Site ARA-25 longer than the assumed 100 years. As a result, monuments were placed on top of the site, as were sign postings and personnel access restrictions that commonly accompany institutional controls.

Table 8-8. Site ARA-25 contaminant concentration evaluation.

COC	Maximum Concentration before Remediation	Maximum Post-remediation Concentration	Remediation Goal
Cs-137	449 pCi/g	398 pCi/g	23 pCi/g
Ra-226	29.7 pCi/g	26.3 pCi/g	1.2 or 2.1 pCi/g[a]
Arsenic	40.6 mg/kg	36.0 mg/kg	5.8 mg/kg
Lead	1,430 mg/kg	1,266 mg/kg	400 mg/kg
Copper	227 mg/kg	201 mg/kg	220 mg/kg

a. A goal of 2.1 pCi/g was used for comparison of sample results that might have included interference from U-235; otherwise, a goal of 1.2 pCi/g was used. Regardless of which remediation goal concentration was used for comparison, the post-remediation concentration clearly exceeds either one.

8.2.11 Inactive Waste System Sites

ARA-II Seepage Pit to the East (ARA-720A) (Site ARA-07)—Based on June 1991 data, the maximum concentration of Cs-137 at Site ARA-07 was found to be 17.6 pCi/g. Accounting for radioactive decay, the corrected Cs-137 concentration (to September 2004) is 13.0 pCi/g. Though cleanup was not required, the residual Cs-137 concentration was still above the free-release concentration of 2.4 pCi/g established at the time. As a result, sufficient Cs-137 contamination existed to warrant institutional controls being established at the site. The institutional controls consist of visible access restrictions (i.e., CERCLA signs) and prevention of unauthorized access (i.e., the INL Site security gate). The institutional control requirement is to be reviewed every five years.

ARA-II Seepage Pit to the West (ARA-720B) (Site ARA-08)—Based on June 1991 data, the maximum concentration of Cs-137 at Site ARA-08 was 11.6 pCi/g. This corresponds to a September 2004 Cs-137 concentration of 8.6 pCi/g. Though cleanup was not required, the residual Cs-137 concentration was still above the free-release concentration of 2.4 pCi/g established at the time. As a result, sufficient contamination existed to warrant institutional controls being established at the site. The institutional controls consist of visible access restrictions (i.e., CERCLA signs) and prevention of unauthorized access (i.e., the INL Site security gate). The institutional control requirement is to be reviewed every five years.

ARA-III Sanitary Sewer Leach Field (ARA-740) (Site ARA-13)—Results from sampling at Site ARA-13 showed that wastes from the manhole were nonhazardous and nonradioactive. The sludge from the septic tank system was also not hazardous but contained levels of Cs-137 below the free-release concentration of 2.4 pCi/g. As a result, a decision was made to manage all sludge from Site ARA-13 as low-level waste. Sludge from the distribution box was found to be regulated under the Toxic Substances Control Act because of polychlorinated biphenyl concentrations in excess of 50 parts per million.

After removal of the sludge from the septic tank and distribution box, no evidence of additional hazardous or radioactive contamination was found in the soil surrounding these systems. In addition, analytical data from the leach field showed that contamination levels were not a problem and that leaving the leach field in place was the best management practice. As a result, the sites can be considered closed, with no further institutional controls required.

ARA-IV Septic Tank and Seepage Pit #2 (Site ARA-21)—Site ARA-21 sampling was done before remediation to determine waste disposition paths for the septic tank, the chlorine contact tank, and the liquid waste contained in them. Based on analytical data, it was determined that the components would be abandoned in place, so sampling of the individual components was not required. Analytical data for Site ARA-21 showed K-40 concentrations of 85.8 ± 22.1 pCi/L in the septic tank and 97.0 ± 26.0 pCi/L in the chlorine contact tank. Gross beta levels were 42.4 ± 3.14 pCi/L in the septic tank and 62.8 ± 4.4 pCi/L in the chlorine contact tank, while gross alpha concentrations were within normal levels. Inorganic and organic analyses indicated that all of the wastes met RCRA regulatory limits. The lack of hazardous or radioactive contamination at Site ARA-21 after remediation allowed for the site to be closed without any institutional controls.

8.2.12 Groundwater Monitoring

The OU 5-12 ROD (DOE-ID 2000) required that nine aquifer wells within WAG 5 be sampled annually to monitor organic, inorganic, and radionuclide contaminant concentrations in the groundwater. The purpose of the monitoring was to compare the measured contaminant concentrations (if any) against the pre-defined maximum contaminant levels (MCLs), secondary MCLs, or EPA-action levels and to ascertain whether the contaminant concentrations are stable, increasing, or decreasing. In addition, up to 21 monitoring wells in vicinity of WAG 5 have been used to determine the elevation of the groundwater, groundwater gradients, and direction of groundwater flow beneath WAG 5. Annual monitoring of WAG 5 wells has been conducted since fiscal year (FY) 2001 (INEEL 2001; INEEL 2002a; INEEL 2003a; ICP 2004).

8.2.12.1 Volatile Organic Compound Results. Sporadic detections of volatile organic compounds (VOCs) have been reported for the WAG 5 groundwater samples, but consistent VOC detections have not occurred. There were scattered detections of the VOCs like toluene and trichloroethene, but detections were not consistent and were well below their respective MCLs except for tetrachloroethene in FY 2003. In the FY 2003 sampling event, tetrachloroethene concentrations above its MCL of 5 μg/L were reported for groundwater samples from wells ARA-MON-A-004 and PBF-MON-A-004. However, tetrachloroethene was below the reporting limit of 1 μg/L in both wells in the FY 2004 sampling event.

8.2.12.2 Inorganic Results. Inorganic analyses included metals and anions. Specific metals requested included arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Anion analysis included fluoride, chloride, bromide, nitrate, nitrite, orthophosphate, and sulfate. In FY 2003 and FY 2004, all analytical results for metals and anions were below MCLs, secondary MCLs, or action levels. In previous sampling events, lead had been detected at concentrations slightly above the EPA action level of 15 μg/L in some wells (Table 8-9).

The cause of the elevated lead concentrations was the galvanized discharge and water-access pipes. Excluding the production well, SPERT I, each of the WAG 5 groundwater monitoring wells were installed with galvanized discharge and water-access pipes. As part of the INL Site routine well maintenance program, pumps were removed and maintained, and galvanized pipes were removed and replaced with stainless-steel pipes. Galvanized pipes removed from WAG 5 wells showed evidence of corrosion and rusting. By FY 2004, the galvanized pipe had been replaced by stainless-steel pipe in the ARA/PBF wells, and the lead concentrations decreased to background levels (Table 8-9). The decline in lead concentrations after replacement of the corroded galvanized pipe implies that the elevated lead concentrations were due to corrosion of the galvanized pipe in the wells.

Table 8-9. Lead concentrations in the WAG 5 groundwater monitoring wells.

Sample Identification Number	Lead Concentration (µg/L) (action level = 15 µg/L)			
	FY 2001	FY 2002	FY 2003	FY 2004
ARA-MON-A-001	9.9	11.9	11.9	2.96[a]
ARA-MON-A-002	6.9	12.7	< 2.5[a]	2.79/2.59
ARA-MON-A-03A	13	**15.6**[b]	< 2.5[a]	NS
ARA-MON-A-004	13.2	**17.0**[b]	< 2.5[a]	2.83
PBF-MON-A-001	1.2[a]	<1.6	<2.5	<2.14
PBF-MON-A-003	<1.1	<1.2	NS	1.8
PBF-MON-A-004	**17.5**[b]	**17.1**[b]	13.9	<1.77[a]
PBF-MON-A-005	<1.1[a]	<1.6	<2.5	2.58
SPERT-I[c]	3.2	<1.6	<2.5	<2.14

a. First groundwater measurement after well casing conversion from galvanized steel to stainless steel.
b. Concentrations are over the EPA-defined action level.
c. Well casing was always stainless steel.

NS = not sampled

8.2.12.3 Radionuclide Results. Radionuclide analyses included gross alpha and beta, gamma spectrometry, tritium, and I-129. The laboratory was requested to do alpha and beta isotopic analyses only if the corresponding gross alpha or gross beta sample result exceeded 5 pCi/L. Because this did not occur for any of the well samples analyzed, isotopic tests were unnecessary. Since 2000, tritium has not been detected in any of the WAG 5 samples.

There were scattered detections of I-129, but no well had consistent I-129 detections. In most cases, the I-129 detections were close to the minimum detectable activity. The one instance when I-129 was detected occurred in 2001 at PBF-MON-A-001 at 1.02 ± 0.26 pCi/L (barely above the drinking water MCL of 1 pCi/L). That detection was attributed to laboratory contamination and flagged UJ, because I-129 was detected in a rinsate sample at a similar concentration and also in the laboratory blank.

There were scattered detections of Cs-134 in FY 2003 and FY 2004. These detections were close to or below the minimum detectable activity for this analysis and were flagged with a "J" by the validator, indicating that the result might be inaccurate or imprecise. Although Cs-134 was found to be present statistically, the result is questionable. Cs-137 is generally expected to be present when Cs-134 is detected, especially given the fact that Cs-134 has a 2.06-year half-life as compared to a 30.17-year half-life for Cs-137. However, Cs-137 was not detected in any of the samples. In addition, reactor operations that could have contributed to the presence of either isotope ceased at PBF in February 1985.

8.2.12.4 Water-level Measurement Results. Water-level measurements were obtained from seven monitoring wells in 2001, eight wells in 2002, 21 wells in 2003, and 19 monitoring wells in 2004 at WAG 5. The number of wells measured for water levels was expanded in 2003 and 2004 to give a better representation of the water table at WAG 5. Like past groundwater contour maps of WAG 5, the contour map of the April 2004 data shows steep contours in the PBF area, with the direction of hydraulic gradient somewhat counter to the regional south-southwest gradient (Figure 8-5).

8.2.13 Institutional Controls

Institutional controls have been warranted for many of the WAG 5 sites because of the presence of radionuclides above concentrations that would allow for free release. Given the revised preliminary remediation goals that have been calculated based on the most recent of the sites EPA guidance (see Appendix A), several sites no longer require institutional controls as described in the following subsections.

8.2.13.1 ARA-I Lead Sheeting Pad near ARA-627 (Site ARA-03). The estimated baseline risk for Site ARA-03 was 2E-05 for the 100-year future residential scenario from exposure to Cs-137 (DOE-ID 1999), with analytical results ranging from 0.49 to 7.4 pCi/g for samples obtained on September 27, 1994. Based on this risk, the ROD (DOE-ID 2000) recommends that the site be restricted to industrial land use until institutional controls are discontinued based on the results of a five-year review. The 1994 data set was evaluated for normality using the Shapiro-Wilk test statistic, which indicated that the data were normally distributed at the 5% significance level. The 95% UCL for the data set using the Student's t was 5.00 pCi/g, which equates to 3.94 pCi/g when decay corrected to January 24, 2005. Based on the concentrations provided in Appendix A, the allowable concentration for the current residential scenario below which institutional controls are no longer required is 5.97 pCi/g. Based on this concentration, institutional controls are no longer required for Site ARA-03.

8.2.13.2 PBF SPERT-IV Leach Pond (PBF-758) (Site PBF-22). Site PBF-22 was the location of an unlined surface impoundment that received effluent from the SPERT-IV reactor from 1961 to 1970. Occasional discharges from the SPERT-IV waste holdup tank were routed to the pond from 1979 to 1981. Contaminated primary coolant effluents from the PBF reactor were transported to the site by truck and emptied into the pond in the early 1980s. Given the results of two separate characterization events in 1988, institutional controls were implemented at the site based on exposure risks being 9E-06 for Cs-137 for the current occupational scenario and 3E-06 for the 100-year future residential scenario, as outlined in the ROD (DOE-ID 2000). The Cs-137 results ranged from 0.073 to 8.0 pCi/g, with an average of 1.10 pCi/g. The 99% Chebyshev UCL (used because the data follow a non-parametric distribution) is 4.42 pCi/g for the 1988 data set. Based on this concentration being below the 5.97 pCi/g requirement for free release, institutional controls are no longer required at this site.

8.2.13.3 PBF SPERT-IV Lake (Site PBF-26). Site PBF-26 is a surface impoundment area constructed in 1960 around an irregularly shaped natural depression. The area typically received small quantities of uncontaminated cooling water from the secondary loop of the SPERT-IV reactor from 1961 to 1970, uncontaminated effluent from Three-Mile Island studies, and discharges generated by periodic testing of emergency eye wash and shower stations from 1985 to 1992. The site is restricted to industrial land use because of estimated baseline risks of 7E-05 for the current occupational scenario and 6E-05 for the 100-year future residential scenario from exposure to radionuclides (Cs-137, U-235, and U-238). Table 8-10 lists the radionuclides detected during the 1985 sampling event, including the range, the average, the 95% UCL (including the data distribution), and the 1E-04 current residential scenario concentrations for the three radionuclides of concern from Appendix A, as calculated based on new slope factors.

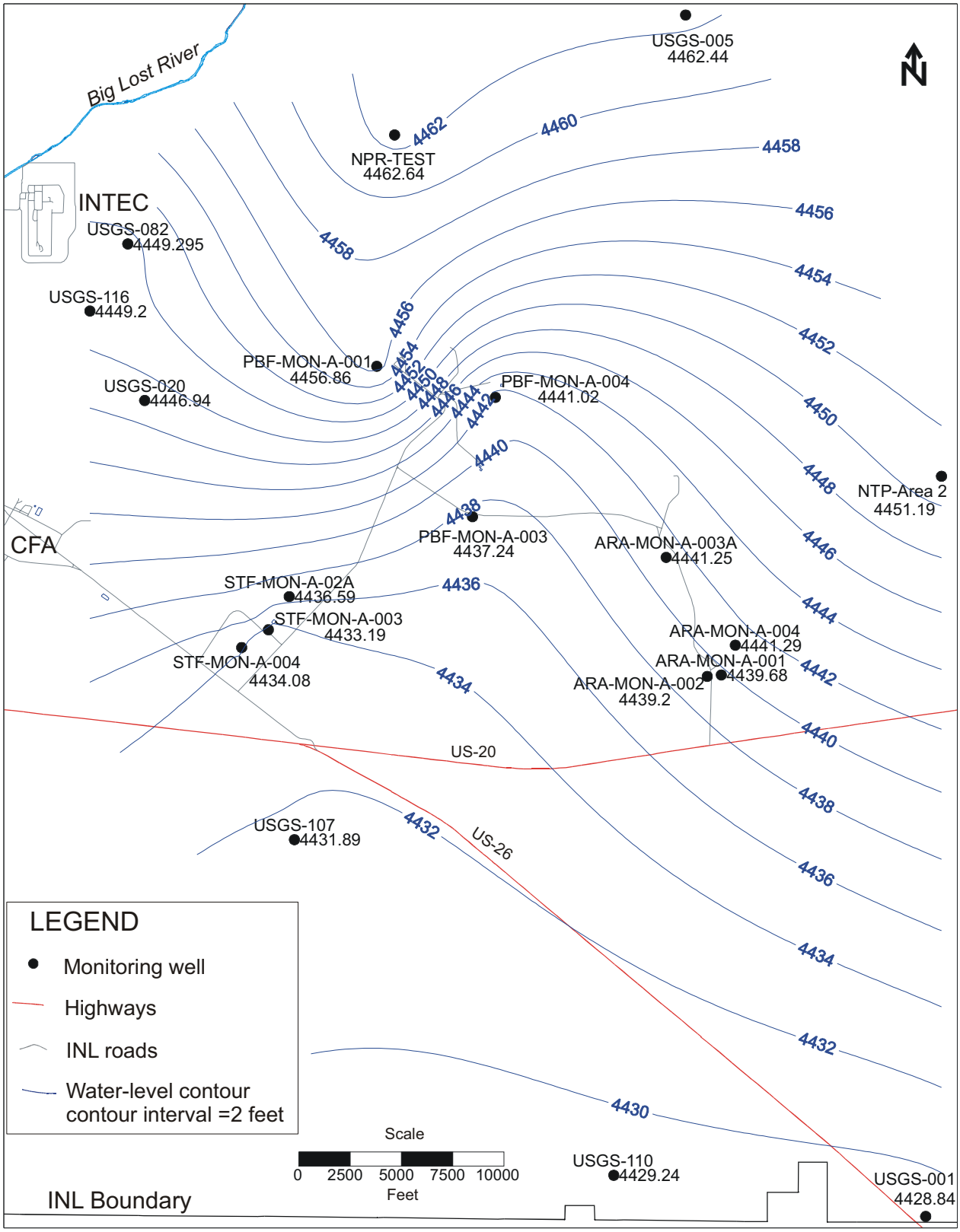

Figure 8-5. WAG 5 groundwater contour map developed from April 2004 data.

Table 8-10. Site PBF-26 radionuclide concentrations.

Radionuclide	Range (pCi/g)	Average (pCi/g)	95% UCL (pCi/g)	Current Residential Scenario (pCi/g)
Cs-137	0.70 – 7.69	2.79	4.67 (Student's t)	5.97 (external exposure)
U-235	0.80	N/A	N/A	19.5 (external exposure)
U-238	0.80 – 3.4	2.1	N/A	74.2 (external exposure)

For U-235 and -238, too few sample results were available from which to calculate the 95% UCL. Therefore, the maximum concentration detected will be used for comparison to the current residential scenario concentration. Both the U-235 and -238 maximum concentrations (0.80 and 3.4 pCi/g, respectively) are below the corresponding current residential scenario concentrations of 19.5 and 74.2 pCi/g. Based on these comparisons, the presence of neither of these radionuclides is cause for institutional control restrictions on the site. Cs-137, with a 95% UCL concentration of 4.67 pCi/g for the 1985 data set, is below the current residential scenario concentration of 5.97 pCi/g. Based on this concentration being below the 5.97 pCi/g requirement for free release, institutional controls are no longer required at this site.

8.3 Progress Since Last Review

The OU 5-05 ROD (INEL 1996) is the only WAG 5 ROD that has undergone a previous five-year review. That ROD addressed the remediation of the SL-1 burial ground. In 2001, the EPA conducted the first five-year review of the OU 5-05 ROD (EPA 2001). The report documented completion of the OU 5-05 remedial action in 1997 and concluded that the engineered barriers placed over the SL-1 burial ground appeared intact, with no visible evidence of subsidence or erosion and no evidence of weeds or shrub encroachment or other biointrusion into the barriers. The revegetated areas surrounding the site appeared to be fixed and well established, with no indication of any surface erosion; all institutional markers (fences, signs, posted notices, and permanent markers) were in place and intact. As a result, the remedial actions performed on the SL-1 burial ground were judged to be effective in meeting the site's RAOs.

A review of the 2002 and 2003 inspection reports (INEEL 2002b; INEEL 2003b) for the SL-1 burial ground showed that conditions were similar to those at the time of the initial five-year review. The engineered barriers still appeared intact, with no visible signs of erosion. Although rabbit nesting was observed in the vicinity of the SL-1 engineered barrier, it appeared very unlikely that the rabbits posed a threat to the integrity of the SL-1 cover. In addition, the revegetated areas surrounding the SL-1 engineered barrier remained free of erosion, and all of the institutional controls are intact and up-to-date. Although vegetation was encroaching on the SL-1 engineered barrier in 2002, vegetation appeared to be absent in 2003. Dose rates around the perimeters of the SL-1 burial ground remained consistent with past survey results. As a result, the remedial actions at the SL-1 burial ground still appear to be effective in meeting the site's RAOs.

8.3.1 Issues Identified during the First OU 5-05 Five-Year Review

The only issue identified during the OU 5-05 five-year review was the presence of windblown contamination in the area surrounding the SL-1 burial ground. The contamination was initially identified as part of the 1998 annual inspection report (INEEL 1998). The five-year review indicated that the windblown contamination was to be removed during Phase II of the WAG 5 comprehensive (OU 5-12)

remedial action. For purposes of completion, the Phase II soil removal action needs to be summarized as part of this review.

The five-year review also mentions that no groundwater monitoring requirements were included in the SL-1 remedy. Rather, groundwater monitoring requirements were addressed by the WAG 5 comprehensive ROD (DOE-ID 2000), which found no unacceptable risk due to impacts on groundwater. Nevertheless, groundwater monitoring was required as part of the first OU 5-12 comprehensive review in order to reduce uncertainties and provide trend data. This monitoring is summarized in Subsection 8.2.12.

8.3.2 Response Actions to Issues Identified During the First Five-Year Review

Since the time of the first review, remediation of the windblown contamination in the vicinity of the SL-1 burial ground was removed as part of the Site ARA-23 soil removal action performed in 2004. Details of the removal action are documented in Subsection 8.1.3.8. The results showed that all contaminated soils were removed to a level below the remedial action goal of 23 pCi/g for Cs-137. However, the residual soil areas within Site ARA-23 maintained a Cs-137 concentration in excess of the free-release concentration of 2.4 pCi/g. In addition, areas within the basalt subsurface that were not excavated indicated Cs-137 contamination in excess of both the free-release concentration and the remedial action goal (2.4 pCi/g and 23 pCi/g, respectively). As a result, institutional controls will need to be maintained over the windblown contamination area as well as the SL-1 burial ground until the Cs-137 contamination in the basalt, waste, and residual soil drops below free-release concentrations.

8.3.3 Ongoing Remediation Activities

As of September 2004, all remedial actions identified in the OU 5-13 ROD, the OU 5-05 ROD, and the OU 5-12 comprehensive WAG 5 ROD have been completed. Details associated with the remedial actions are contained in the respective remedial action reports for each ROD (INEL [1992a] for OU 5-13; INEL [1997] for OU 5-05; and DOE-ID [2002] and a report to be published for OU 5-12).

The only ongoing remediation activity is the groundwater monitoring activities that are under way as part of OU 5-12.

8.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

According to sampling data and site inspections, all COCs are at or below regulatory action levels. However, at some of the sites, contaminants are present at concentrations that prohibit unrestricted use of or unrestricted access to the site. At sites where contaminant concentrations prohibit free release of the site, institutional controls have been implemented. Therefore, the remedial actions implemented at WAG 5 are functioning as intended.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

No changes that would negatively impact the original assumptions for exposure assumptions or toxicological parameters have occurred since development of final remedial goals. Therefore, the original assumptions, cleanup levels, and RAOs used at the time of the remedy selection are still valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No.

8.5 Issues

Based on recent EPA-approved guidelines, the revised free-release concentration for Cs-137 is 5.97 pCi/g. This is due to a soil shielding factor that was included in the latest risk models. Before the next five-year review, the U.S. Department of Energy Idaho Operations Office, with agency concurrence, will determine how best to address the impact that the new guidelines have on the duration of institutional controls. For WAG 5, the new guidelines would allow for institutional controls to be discontinued at Sites ARA-03, PBF-22, and PBF-26.

8.6 Recommendations and Follow-up Actions

The institutional controls that are currently in place for 13 waste sites within WAG 5 appear to be functional and should be left in place for most of the sites until the radioactive residual contamination in these sites drops below free-release concentrations. The free-release concentration for Cs-137 (the primary radionuclide COC) was established at 2.4 pCi/g, which is equivalent to a 1 E-4 risk for residential use.

As stated above, a four-year review of groundwater monitoring activities within WAG 5 showed that the existing groundwater flow and elevation underneath WAG 5 are not varying significantly, and that the concentrations of organic, inorganic, and radionuclide contamination in the groundwater are substantially below EPA-defined regulatory levels. As a result of these findings, it is recommended that the majority of inorganic, radionuclide, and groundwater-level monitoring should be terminated at WAG 5. To provide adequate data for wells that have undergone replacement of the galvanized piping with stainless-steel piping within the past two years, an additional round of samples will be collected specifically for lead and zinc analyses. Provided that this additional round supports the assertion that contaminant concentrations have decreased to acceptable levels, sampling for these analytes will be discontinued. Organic groundwater monitoring be continued on only the three monitoring wells (PBF-MON-A-001, PBF-MON-A-003, and SPERT I) within the vicinity of the PER-722 diesel fuel release behind the PBF Reactor Building (PER-620). Furthermore, it is recommended that organic groundwater monitoring of these three wells be terminated in 2006 if monitoring results continue to indicate organic contaminant concentrations in the groundwater are below regulatory concern.

8.7 Protectiveness Statement

Review of the results of the groundwater monitoring activities and annual inspection reports conducted at WAG 5 since 2001 shows that the remedy is functioning as intended by the OU 5-12 comprehensive ROD (DOE-ID 2000) and as modified by its ESD (DOE-ID 2005). No changes in the physical conditions of the site have occurred that would affect the remedy's protectiveness. As of September 2004, no changes have occurred in the COC toxicity factors or risk factors that would negatively impact the protectiveness of the remedy. A total of 13 hazardous sites within WAG 5 remain under institutional controls. In addition, recommendations are to continue groundwater monitoring for organic contamination on three of the monitoring wells within WAG 5 (PBF-MON-A-001, PBF-MON-A-003, and SPERT-I). However, all of these actions are in accordance with the intent of the OU 5-12 ROD. None of the available information negates the protectiveness of the OU 5-12 remedies.

8.8 Section 8 References

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